

FLIGHT

The
AIRCRAFT ENGINEER
AND AIRSHIPS

First Aeronautical Weekly in the World. Founded January, 1909

Founder and Editor: STANLEY SPOONER

A Journal devoted to the Interests, Practice and Progress of Aerial Locomotion and Transport

OFFICIAL ORGAN OF THE ROYAL AERO CLUB OF THE UNITED KINGDOM

No. 1309. (Vol. XXVI.) 26th Year.

JANUARY 25, 1934

Weekly, Price 6d.
Post Free, 7½d. Abroad, 8d.

Editorial Offices: 36, GREAT QUEEN STREET, KINGSWAY, W.C.2
Telephone: (2 lines), Holborn 3211 and 1884.
Telegrams: Truditur Westcent, London

Subscription Rates, Post Free.

UNITED KINGDOM			OTHER COUNTRIES		
	s.	d.		s.	d.
3 Months ..	8	3	3 Months ..	8	9
6 " ..	16	6	6 " ..	17	6
12 " ..	33	0	12 " ..	35	0

CONTENTS

Editorial Comment:	PAGE
Our Air Lines and the P.M.G.	69
Outward Services	70
British Enterprise in China	71
Some New British Types	72
Air Transport: The Lockheed "Electra"	74
Christmas in the Air	76
From the Clubs	78
THE AIRCRAFT ENGINEER	78A
"Ethyl": By F. R. Banks	79
Views from the Four Winds	82
The Gipsy Six	84
Airport News: "The London Air Terminal"	87
Royal Air Force	89
Aircraft Companies' Stocks and Shares	90

EDITORIAL COMMENT



IGNORANCE of the law is said to be no excuse, but we are glad that the enterprising air company which carried some letters the other day without a licence from the Postmaster-General are reported to have suffered nothing worse than a warning. Bureaucrats, it seems, though devoid of soul, may be kind of heart. Had stronger measures been taken, the P.M.G. might have been shown up in a light very much less favourable, for after all if our inland letters may not take advantage of air transport, who is to blame but the P.M.G.?

Our Air Lines and the P.M.G.

The Post Office monopoly must be preserved. We are all socialists on that point. Many criticisms are directed against the Post Office from time to time, but they seldom concern the delivery of letters. It is the general opinion of the public that this, the chief function of the Post Office, is carried out quite as well as, if not better than, any private company could do it. The telephone service is another matter, and so is the use made of the £11,000,000 or so of surplus earned by the department. Still, most people are agreed that once a stamp bearing the effigy of our Gracious King has been purchased and stuck on the missive, and has been defaced by the official black marks, it is the duty and privilege of the postal servants of His Majesty to carry that missive to its destination. What is more, no other party may carry letters for hire or reward without a licence. It is for the P.M.G. to decide which is the best way to transport the letter, unless a special surcharge is paid.

As a general rule, the P.M.G. has decided that certainty is better than speed. The train is the stock means of transport, but many other agencies are employed. Ships, of course, must be used. Motor vehicles of various sorts are also common in the service of the mails. In India the mail runners, armed with a short spear hung with jingling bells, carry the mails over many miles of jungle, and not infrequently fall victims to tigers or other wild beasts. Pedal bicycles have often been used by the Post Office, while, perhaps strangest of all, up the stepped

DIARY OF CURRENT AND FORTHCOMING EVENTS

Club Secretaries and others desirous of announcing the dates of important fixtures are invited to send particulars for inclusion in this list:—

- 1934.
- Jan. 30. Croydon Airport Annual Dinner and Dance.
- Feb. 1. "Engine Cowlings." Lecture by J. D. North before R.Ae.S.
- Feb. 2. Cinque Ports Flying Club Annual Dinner and Dance, Royal Pavilion Hotel, Folkestone.
- Feb. 10. Services Rugby: R.A.F. v. R.N., at Twickenham.
- Feb. 16. Bristol and Wessex Ae.C. Annual Ball, Grand Spa Hotel, Clifton.
- Feb. 16. De Havilland Technical School Annual Ball, Stag Lane, Edgware.
- Feb. 21. "Development of Aircraft and Its Influence on Air Operations." Lecture by Sq. Ldr. R. V. Goddard before R.U.S.I.
- Feb. 22. Herts and Essex Ae.C. Annual Dinner and Dance, Wharnclyffe Rooms, Hotel Gt. Central, London.
- Mar. 15. "Some Developments in Aircraft Construction." Lecture by H. J. Pollard before R.Ae.S.
- Mar. 21. "Some Problems of a Technical Service." Lecture by Wing Com. G. W. Williamson, before R.U.S.I.
- Mar. 24. Services Rugby: R.A.F. v. Army, at Twickenham.
- Mar. 29. "Results from the Compressed-Air Tunnel." Lecture by E. F. Relf, before R.Ae.S.
- Apr. 5. "Engines." Lecture by Capt. A. G. Forsyth before R.Ae.S.
- Apr. 27-May 6. International Aero Show, Geneva.
- May 17-June 2. Royal Tournament, Olympia.
- May 27. Deutsch de la Meurthe Cup.
- June 1. Entries close at 12 noon for London-Melbourne Race.
- June 30. Royal Air Force Display, Hendon.
- July 3-9. 4th International Congress for Applied Mechanics Cambridge.
- July 21-22. French Grand Prix.

streets of Clovelly His Majesty's mails are carried by asses.

All these forms of transport are regarded as reliable. Only the aeroplane is still held suspect by the P.M.G. He has in course of time and by force of circumstances been obliged to recognise and patronise the newest and fastest form of transport. It would, perhaps, be unkind to say that the patronage has been grudgingly given, or to aver that the fairly generous advertisements of the air mail which are now pasted on red P.O. delivery vans are due to the insistent badgerings of certain Members of Parliament, but it never seems that the P.M.G. is eager to seize the latest chance to use what aerial facilities are offered. Of late a number of inland air services have been started in the United Kingdom, and during the fine summer last year they achieved a high degree of reliability, but we understand that none of them were actively pressed to carry mails. In fact, we fancy that only the Great Western Railway air service was commissioned to carry them, perhaps because already railways are allowed, by special arrangement, to carry letters direct. In some cases, perhaps, delivery of the letters might not have been expedited by use of the aeroplane, and in most cases there would have been risk of delay through weather or mechanical trouble. But it does appear to us that in a case like the air service to the Orkneys letters might have been sent by aeroplane at the sender's own risk. Can the answer be that the air company did not ask for the privilege? Such an excuse would not seem to us adequate. The saving of time to the correspondents would have been so considerable that it should have been the business of the Post Office to take the initiative in the matter. Such a service may stop flying in the winter. Then the people in the Orkneys are no worse off than before, but that is no reason why they should not benefit by the speed of the aeroplane in the summer. A little practical enthusiasm on the part of the P.M.G. in this matter could do no harm and would certainly do quite a lot of good.

❖ ❖ ❖ ❖

The granting of a monopoly of subsidies to Imperial Airways some years ago by Sir Samuel Hoare has been justified by results. The time is approaching when subsidies will no longer be a *sine*

**Outward
Services**

qua non for a remunerative air service, and, in fact, whenever Imperial Airways are accused of leaving undone something which someone thinks that they ought to have done, their regular reply is that they are working to make themselves self-supporting. Nobody can find fault with that excuse. Once Imperial Airways are firmly on their feet (if a flying company will excuse such an expression) it may be wise to consider whether other companies should not receive a little initial support from the State. Probably for a long time to come no really ambitious air scheme will be able to make a start without some State

assistance, but in the future it may not be necessary to give such help for more than a short time. Experience in running an air line has now been accumulated, and also the prospects of traffic can now be estimated with a fair degree of accuracy. The question arises of whether we ought to be satisfied to see a number of foreign air lines flying into Great Britain, and only one British line flying outwards. That British line flies to Paris and Brussels, taking the shortest crossing of the Channel, and from those two points carries on to certain others. All the air transport of Europe north of London is left to foreign lines, though those lines nearly all send their machines to England. Air traffic through Holland and Denmark up to Scandinavia ought to be very profitable some day, even if it is not so already, and the North Sea ought to be as free to British aircraft as it is to those of Holland and Germany.

It is an impressive sight for those towns on the lower reaches of the Thames to see the three-engined Fokker monoplanes flying up the river after crossing some 200 miles of open sea with perfect confidence. They have this additional confidence, too, that very rarely does fog hamper them as they follow the Thames. The North Downs tower above the river fogs, and then if Croydon is signalled as fog-bound, the Fokkers can land at the aerodrome on the high ground above Gravesend and can send their passengers on to London almost as quickly as they can be taken in from Croydon. Sometimes the low-wing Junkers monoplanes are also sighted on this route. The riverside dwellers would be immensely heartened if they sometimes could see a British passenger aeroplane over their heads. One wonders whether their patriotic desires are altogether unreasonable.

The latest development is that K.L.M. will commence on June 1 a daily service between Amsterdam and Hull. It takes a glance at the map to make one realise that Amsterdam is almost equidistant from London and Hull. There is only a difference of about half-a-dozen miles in the two routes. The Amsterdam-Hull route means crossing more open sea, but the K.L.M. have great confidence in their three engines. We personally should feel happier in a flying boat, but, none the less, the K.L.M. record of safety is excellent. The North Sea company have had the desire to open this route for a long time past, and it seems a great pity that now, when the dangers of flying across the open sea are so much less than they used to be, it is a foreign firm which is to carry out the project. We should like to think that it was possible to fly from England to Scandinavia in British aircraft. The K.L.M. propose also to fly on to Manchester, right across northern England. Mr. Plesman states that the service will not be subsidised, and we must congratulate the company on its enterprise. Manchester commerce will benefit by rapid communications with Holland and Scandinavia, but it would be infinitely more gratifying if that could be brought about through a British air company.



BRITISH ENTERPRISE IN CHINA

IT will come as an agreeable surprise to many of our readers to know that a single concern—the Far-East Aviation Co., Ltd.—has supplied about 130 British aircraft of both military and civil types to China during the past three years. A short history of the company should be of interest.

In 1928 Mr. R. Vaughan Fowler and Mr. F. R. Smith started the business as a private company. When he came to England in 1930 Mr. Vaughan Fowler made arrangements to represent in China the majority of British aircraft firms. On his return he was accompanied by Mr. A. V. Harvey, who became the chief test pilot and demonstrator of the company. A limited liability company with the title of The Far-East Aviation Co., Ltd., was formed in 1930 with a capital of half a million Hong Kong dollars. The managing director is Mr. Vaughan Fowler; Mr. Harvey is the manager for Hong Kong and South China. Besides its aviation activities the company is responsible for Far Eastern Motors in Hong Kong. At the present time a flying training school, which will be run on similar lines to the School of Air Service Training,



ADVANCED TRAINING: Mr. A. V. Harvey and two Chinese pilots with an Avro 626 ("Lynx").

is being formed. In return for an annual grant of 30,000 Hong Kong dollars, the school undertakes to train ten members of the Hong Kong Volunteer Defence Corps each year. It is thought that a number of Chinese Government students will take ground engineers' courses at the school.

Mr. F. W. Murray, late of A.S.T., has already left for Hong Kong to take up the duties of chief instructor to the school, and Lord Malcolm Douglas Hamilton will follow in January to assist him. Another former member of the staff of A.S.T., the chief ground engineer and foreman, Mr. Waldron, is going out in January to take up a post with the company. He will be assisted by Mr. Wilcocks. The initial equipment of the school will be three Avro "Cadets" (7 cyl. "Genets"). Later two Avro 626 ("Lynx") advanced training machines and possibly a "Cutty Sark" (2 "Genet Majors") will be added. The instructional staff of the company includes Messrs. H. A. Howes, A. D. Bennett, G. S. Jones-Evans, G. B. Mussom, Flt. Lt. J. R. Brown, L. Rowley, and a Chinese pilot, Mr. Hung.

The following types of machines have been sold in China by the company:—Avro "Avian," Avro "Cadet," Avro 621, Avro 626, Avro 637, Avro VI, A.W.XVI, "Atlas II," Westland "Wapiti," and Saro "Cutty Sark." All these aircraft are fitted with Armstrong Siddeley engines ranging from the "Genet" to the "Panther." The interchangeability of the parts of many of these Armstrong Siddeley engines is a great asset in a country such as China. The Avro 637 type should be particularly well suited to Chinese demands.

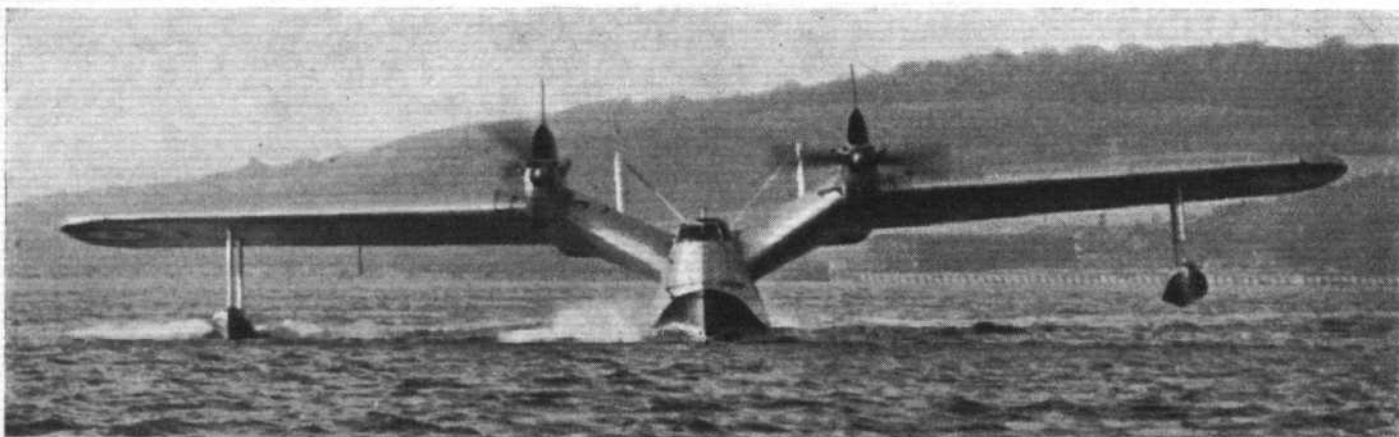
The greatest competitor of Great Britain in the Chinese aircraft market is America. The Curtiss "Hawk," Douglas "02.Mc" and Vought "Corsair" military types are all employed. Junkers K.47 two-seater fighters and some Fiat BR.3 bombers are also to be found. Since the conflict between China and Japan several patriotic Chinese have subscribed to purchase aircraft. The Honan Provincial Government has donated several of these machines. The purchase was followed up by an order for more, which only goes to show what our manufacturers can do abroad if they really try.



THE MANAGING DIRECTOR: Mr. R. Vaughan Fowler, a pioneer of the business.



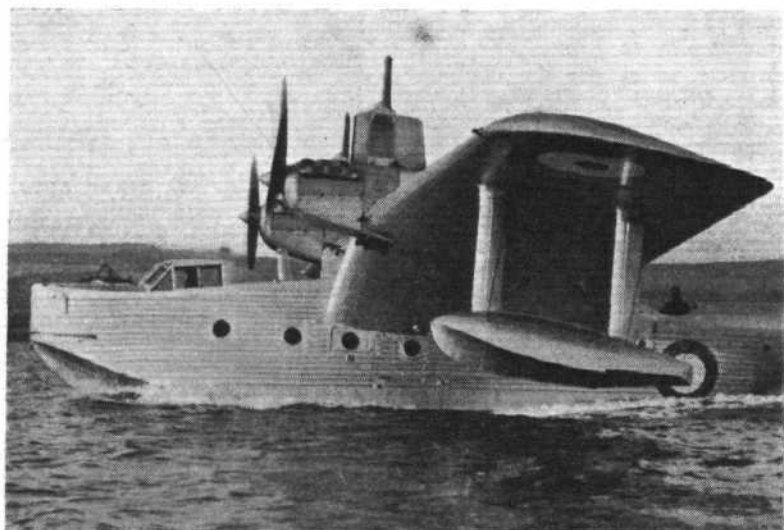
FIGHTING EQUIPMENT: Three A.W.XVI's ("PantherIIa") at Shanghai. The ruins in the background, before a Japanese bombardment during the first Sino-Japanese conflict, were hangars.



SOME NEW BRITISH AIRCRAFT TYPES

AFTER many months it has become permissible to publish this week photographs of some new aircraft types recently completed for the British Air Ministry. On this page we show pictures of the new Short monoplane flying-boat (Rolls-Royce engines) which was launched at Rochester a few weeks ago. This machine is a complete departure from previous Short machines of large type, the cantilever wing with the curious "bend" in them being one feature, and the flat-sided tumble-home sides of the hull another. By raising the wings in the manner shown, the engines and airscrews are brought well clear of the water. On its preliminary tests the machine, which has a wing span of 60 ft. and a gross weight of $8\frac{1}{2}$ tons, proved itself very fast indeed. It is to be hoped that it will prove the military forerunner of a series of commercial boats.

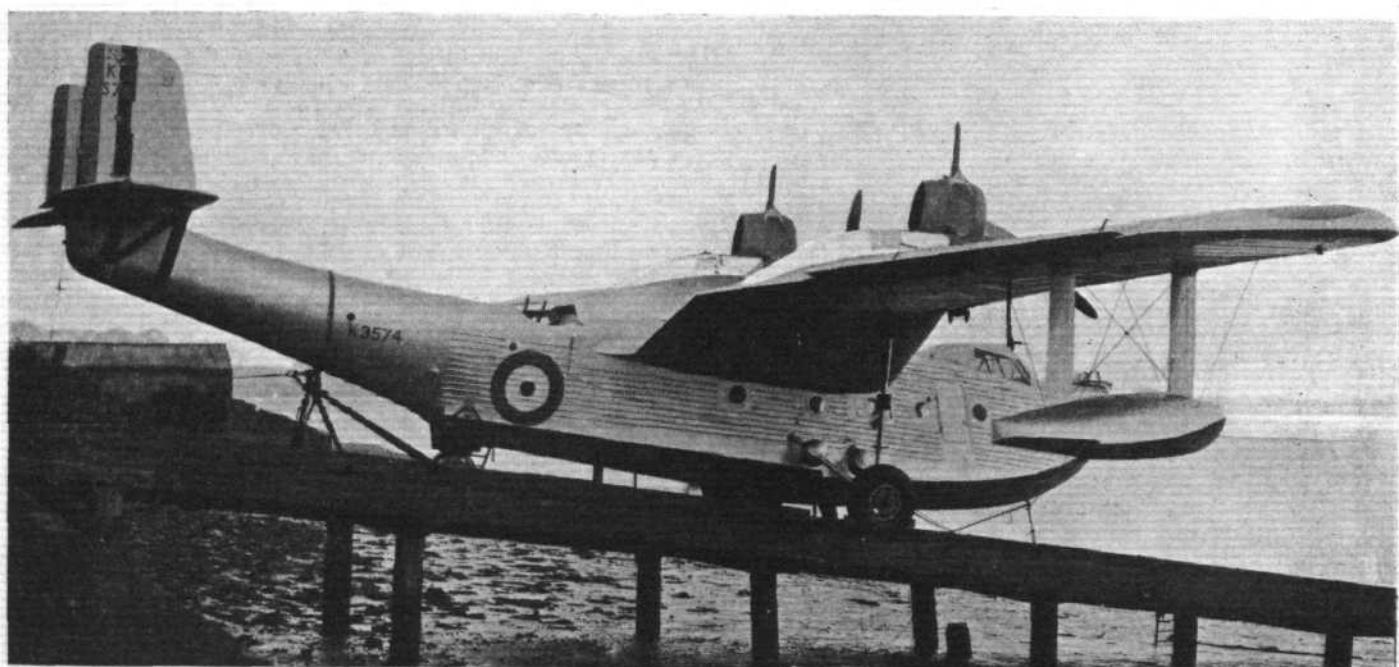
The Hawker "Hart" with Napier experimental engine is a standard type except for the engine, and a careful study of the nose may give our readers an inkling of what the engine inside the cowling is like. Further assistance than that we are not permitted to give them. Should any reader be fortunate enough to see the machine



THE SHORT R.24/31 : Raising of the wings by giving a large dihedral angle to the wing roots, and the disappearance of the bulging chine are features of this machine. The engines are Rolls-Royce experimental.

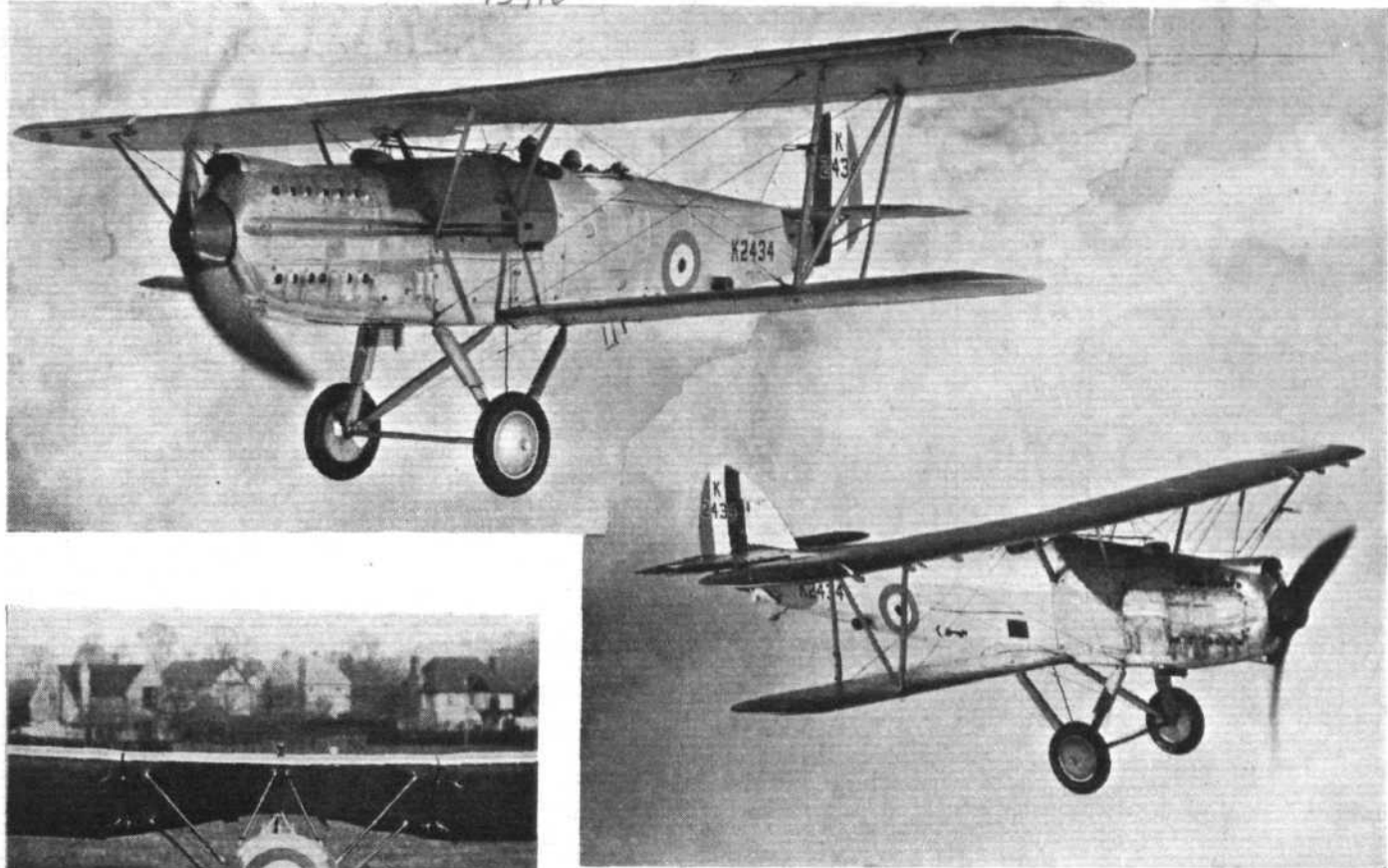
over the North London district, they will find that it is not necessary to line it up over two fixed points to make sure that it is moving.

The Gloster machine shown on the next page is a "P.V." (Private Venture) designed for Fleet spotting, reconnaissance and torpedo work. The engine is a Rolls-Royce, and the machine is a three-

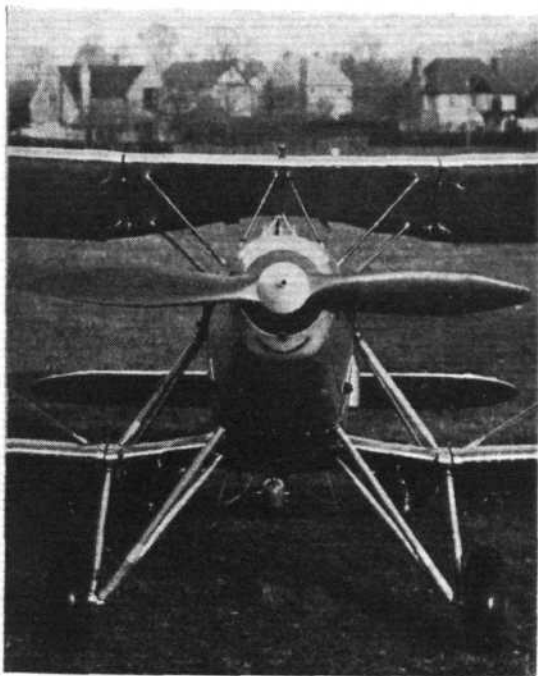


ON THE SLIPWAY : This view of the Short R.24/31 gives a good idea of the lines of the hull.

13716



THE HEART OF THE "HART": The two views above show a Hawker "Hart" fitted with a Napier experimental engine. The shape of the nose may give an indication of the engine inside. On the left a front view of the central portion of the new Gloster Fleet Spotter Reconnaissance Torpedoplane. (FLIGHT Photos.)



seater. The main general features can be seen in the photographs. It will be noted that the machine shows the split undercarriage braced via the wing roots to the fuselage, as usually found on torpedoplanes which have to be folded. In spite of the relatively great distance to the outer struts, there is but a single pair, wherein the new Gloster Fleet Spotter differs interestingly from the much smaller "Gauntlet" single-seater fighter, which is a two-bay biplane. The centre-section strut bracing forms, to some extent, the equivalent of the other bay.



A GLOSTER "PV" MACHINE: Undergoing tests at Brockworth Aerodrome, piloted by Capt. H. J. Saint, D.S.C., Chief Pilot to the Gloster Aircraft Co., Ltd. The engine is a Rolls-Royce. (FLIGHT Photo.)

Air Transport & Commerce

THE LOCKHEED "ELECTRA"

The latest Lockheed product
which cruises at 180 m.p.h.
with a 2,200 lb. payload

THE Lockheed "Electra" is an all-metal low-wing monoplane of comparatively small overall dimensions and low power, but possessing a remarkable performance as the result of clean aerodynamic design.

The all-metal wings are of full cantilever construction, the centre section being built integral with the fuselage. To facilitate the replacement of damaged wings, the outer sections are detachable from a point just outside of the nacelles. The surface is smooth skin throughout, and rivets are made flush over part of the upper surface where they would offer resistance. The construction is of the "stressed skin" type, with heavy corrugations under the skin, making it possible for a person to walk down the centre portion of the wing without causing damage. The skin over the centre section and part of the outer wings is of heavy-gauge duralumin of the latest type manufactured by the Aluminium Company, namely, 24 S.T. All outer skin is Alclad 24 S.T., which has remarkable corrosion-resisting properties. The interior of the wings and centre section are carefully cleaned and coated with Lionoil. The centre section, which contains the nacelles, fuel tanks and cargo compartments, is cut away at the fuselage, which is placed partly within the wing, giving the aircraft a very small frontal area. The ailerons are in the conventional positions at the trailing edge and tip. Inboard of the ailerons are the wing flaps, which extend through under the fuselage. These flaps give an increase in lift of approximately 25 per cent. and a large increase in drag. Although a reduction in the load

THE LOCKHEED "ELECTRA" MODEL 10A

2 "WASP JUNIORS," TYPE S.B.

Dimensions

Length ..	38 ft. 7 in.
Span ..	55 ft.
Root chord ..	145 in.
Tip chord ..	48 $\frac{1}{2}$ in.
Wing area ..	458.3 sq. ft.
Wing incidence ..	0 deg.
Dihedral—median line ..	5 deg. 34 min.
Aerofoil section ..	(root) Clark Y-18, (tip) Clark Y-9.
Wing taper in plan ..	3-1.
Aspect ratio ..	6.6.
Overall height ..	10 ft. 1 in.
Track ..	13 ft. 7 in.
Airscrews ..	Smith control- lable pitch.

Passenger cabin capacity	300 cu. ft.
Front baggage compartment ..	40 cu. ft.
Wing baggage compartment ..	28 cu. ft.
Maximum width of cabin	58 $\frac{1}{2}$ in.
Maximum height of cabin	60 in.

Areas

Fin ..	15 sq. ft.
Rudder ..	16.9 sq. ft.
Tail plane ..	48 sq. ft.
Elevators ..	33.6 sq. ft.
Ailerons ..	29.2 sq. ft.

Weights

Gross weight ..	9,000 lb.
Weight empty ..	5,455 lb.
Disposable load ..	3,545 lb.
Power loading ..	10.71 lb./h.p.
Wing loading ..	19.64 lb./sq. ft.

Performance

Maximum speed at 8,000 ft.	215 m.p.h.
Cruising speed at 5,000 ft.	190 m.p.h. at 2,000 r.p.m.
Landing speed at sea level (with flaps) ..	63 m.p.h.
Maximum rate of climb at sea level ..	1,350 ft./min.
Service ceiling ..	20,000 ft.
Fuel capacity ..	200 gall.
Oil capacity ..	14 gall.
Cruising range ..	750 miles at 48 gal./hr.
Cruising duration ..	4.17 hr. at 48 gal./hr.

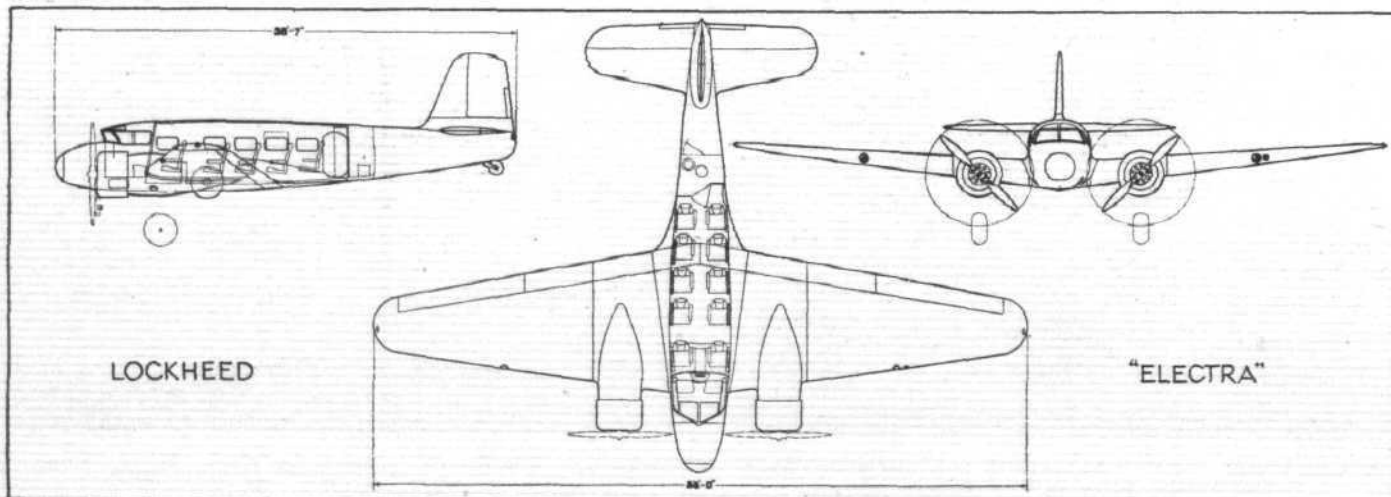
factors for multi-engined transports has been allowed by the Department of Commerce, this has not been used in the wings of the "Electra." In fact, the whole machine has been designed to single-engine factors.

The monocoque fuselage is constructed entirely of 24 S.T. duralumin. A smooth skin of Alclad 24 S.T. is used throughout. This skin is reinforced and held in place at frequent intervals by channel bulkheads and longitudinal stringers. The skin over the passenger cabin is 0.032 in. thick. Special attention has been given to the tail of the fuselage to give rigid support to the cantilever empennage and tail wheel. Seating accommodation is provided for ten passengers, but fewer passengers and a correspondingly larger baggage or mail load may be carried. A lavatory is situated at the rear of the cabin.

The tail plane and elevator rest on top of the fuselage in which position the maximum protection is afforded from flying stones. Forward of the pilot's cabin is a baggage compartment of 40 cu. ft. capacity, reinforced so that the baggage will not injure the outer skin of the fuselage. A removable tail fairing forms the end of the fuselage and houses the tail wheel. Easy access is given to all moving parts of the empennage.

The engine nacelles are located directly ahead of the leading edge of the wing. According to tests conducted by the N.A.C.A., this arrangement gives the lowest drag and the maximum lift. Wind tunnel tests with the "Electra," with and without nacelles, proved that the lift was the same in each case. The nacelle structure and engine mountings are of steel tubes. Numerous large holes are provided for inspection. The nacelle not only supports the engines but also the landing gear and retracting mechanism.

The tail surfaces are cantilever metal structures with smooth skin covering. Fin and tail plane are



THE LOCKHEED "ELECTRA": A photograph of a model. The arrangement of the cabin windows in the actual aircraft will differ from that shown here; the front windows will slope inwards in the latest American fashion.



not adjustable but are bolted direct to the fuselage. The rudder and elevator, both of which are adjustable from the cockpit, are fitted with "tabs." The word "tab" has been approved by the Department of Commerce as the name for auxiliary control flaps. In place of the usual type aerodynamic balance for ease of control, the rudder and elevator loads are lightened by making the tab act not only as a Servo but as a trimming device. The control surfaces have removable tips which may be replaced in case of damage. To eliminate any possibility of flutter the elevators are statically balanced.

The wheels of the retractable landing gear are located directly under the engine nacelles into which they retract by swinging back and up. When the wheels are retracted a small portion of the tyre is left exposed in case of a forced landing. The landing gear is electrically operated by means of gears and torque shafts. One motor operates both wheels. The operation is automatic in that when the switch in the cockpit is operated for retracting the gear, the gear rises, and when up, the motor stops without further action by the pilot. Auxiliary hand mechanism is provided to raise and lower the gear in case of failure in the electrical system. The Goodyear air wheels are fitted with hydraulically-operated brakes, which may be applied with the landing gear either up or down. The Aerol shock-absorber struts have a stroke of 6 in. An Aerol strut, also with a 6-in. stroke, is provided for the tail wheel.

Soundproofing of the cabin has been carried out under the direction of the Western Electric Company, and 1½ in. of space has been allowed all the way round the cabin. The doors are heavily soundproofed and are of the same thickness as the cabin walls. Special latches hold the doors tightly shut at all times, allowing almost no sound leakage. An efficient ventilating system combined with a thermostatic heat control maintains correct cabin temperature and assures proper fresh-air conditions.

Complete dual controls are fitted and are so designed that the set on the right-hand side may be disconnected if desired. The control columns are not in the centre of the seat, but to the side as far as possible. This arrangement permits the pilots to leave and return to their seats while in flight with little inconvenience. The rudder bar is adjustable to suit pilots of various heights. All control surfaces are operated by steel cables at points of adjustment to the control column and control surfaces. The cranks are made as arcs of circles, thereby eliminating the possibility of tension or slackness eliminating possible source of surface flutter. The differential ailerons have a down movement of only 4 deg., while the upward movement is 25 deg.

THE HULL-AMSTERDAM SERVICE

As the result of a meeting between representatives of K.L.M. (Mr. A. Plesman and Mr. de Vries) and the Hull Corporation Aerodrome Committee, it was announced by the Town Clerk on Monday, January 22, that, starting on June 1, an air service will be operated between Hull and Amsterdam. One service will be flown each day, and the estimated fare for the single trip will be £5 per passenger. It seems that, besides Hull, Manchester will be used as a terminus for the service. The K.L.M. representatives had flown over from Amsterdam in a Fokker, piloted by Capt. Smirnoff, the journey being accomplished in about 2 hours. It may be remembered that the Hull aerodrome has been leased by the Corporation to National Flying Services, Ltd. It was revealed recently by Mr. G. K. Spruit, Deputy Chairman of the Corporation Aerodrome Committee, that it is expected that the agreement whereby the Corporation would regain control of the aerodrome and take over the assets of the company will soon definitely be settled. The establishment of the Hull-Amsterdam service should have a big effect on the Hull Aero Club. At a recent meeting,

Complete two-way Western Electric radio is installed in the passenger cabin under the two front seats. These seats are located just at the head of the spar and are hinged to it. The hinges allow the seats to be raised up and laid back, permitting easy access to the radio for inspection or repair. Controls for the radio are mounted on a separate instrument board located below the main board. All wiring throughout the machine is placed in aluminium conduits with metal junction boxes entirely eliminating the possibility of fire from the electrical wiring system.

Two fuel tanks are carried, located one in the leading edge of each wing between the engine nacelle and the fuselage. For rapid filling the tanks are furnished with large filler necks 3 in. in diameter, which are surrounded by gas-tight metal cylinders permitting no fuel to spill into the wing when the tanks are overflowing. The tank compartment in the wing is drained and ventilated to prevent any accumulation of fuel or fumes in case of fuel leakage, and both tanks may be withdrawn from the aircraft with little inconvenience. There are two oil tanks, one for each engine, located in each nacelle just ahead of the fire-proof bulkhead.

The two "Wasp Junior" engines (420 h.p. at 2,200 r.p.m. at 5,000 ft.) are bolted to welded steel tube mountings which are fitted with shock-absorber units of the Lord type. A Pratt & Whitney oil regulator and heater assembly eliminates the usual type oil radiator. The engine controls from the pilot's cockpit are of the Arens push-pull type. N.A.C.A. cowlings and small inner cowls are provided for the engines. The leading edge of the outer cowl is in one piece and is not readily removable, making a rigid support for the entire outer cowl. All the cowl aft of this nose piece is quickly removable. The nose piece has been placed far enough ahead of the rocker boxes to permit inspection and adjustment of valves and rocker arms. Both fuel and oil pumps are made from the Aluminium Company's latest type 4 S.O. aluminium with Parker duralumin fittings.

Mr. G. E. S. Lamb, the Chairman of the Club, said that there would be something most definitely important taking place on the aerodrome every day, and that would mean they would get more people there. The airline passengers would also use the club, which would perhaps become, in a measure, an hotel. Alderman Pearlman, of Hull, has stated that it is his ideal to make Hull "the Croydon of the North."

SPANISH TRAFFIC FIGURES

We give below the traffic figures of the Lineas Aereas Postales Españolas from January to September, 1933. The corresponding figures for last year are also given. They refer to the Madrid-Barcelona and Madrid-Seville connections.

	Flying Hours	Miles	Passengers	Mail, Lb.	Luggage, Lb.	Freight Lb.
1933	2,702	254,600	3,600	126,844	90,022	33,350
1932	3,107	292,679	4,983	141,725	97,366	40,538

Christmas in the Air

MOST people on Christmas Day, whether they be in their own homes, travelling, or in whatever state it has pleased Providence to call them, endeavour to celebrate that anniversary by means of something extra special in the way of food and drink. Imperial Airways always look after their passengers better, perhaps, than any other transport company in the world, and an amusing and effective example of this care is given by the Christmas lunch so carefully arranged for the passengers in *Scipio*, the four-engined Short flying boat which was to leave Brindisi on the morning of December 25, 1933, for Athens.

The programme did not go quite to schedule owing to delays of the train service which Imperial Airways passengers still unfortunately have to make use of between Paris and Brindisi. The machine actually left Brindisi at 8.15 a.m. on December 26, but the passengers, after consultation, were unanimous in their desire to have the Christmas luncheon which, but for the delay, they would have had on the previous day.

The staff of the *Scipio*, in command of Capt. F. J. Bailey, had decorated the cabin very carefully with holly, mistletoe and paper streamers, and a Christmas tree had been rigged up. This was suitably decorated and hung with gifts for each of the 14 passengers, in the shape of Imperial Airways diaries with the passenger's names stamped thereon. The tree was a fully illuminated one, with coloured lamps lit from the ship's electrical system.

The lunch, which had been supplied by Fortnum & Mason, Ltd., was a great success. The turkey was served cold, but the soup, sausages, potatoes and pudding were all hot. Just how this was done had better remain a



NOEL ! Imperial Airways' way of looking after their passengers on Christmas Day.

Imperial Airways wish you a Merry Christmas

MENU

Mulligatawny Soup
Roast Turkey
Sausages
Cranberry Sauce
Boiled Potatoes
Green Peas
Christmas Pudding
Brandy Sauce
Stilton Cheese
Biscuits
Fruit
Coffee

Perrier Jouet
1923 Port

secret of Imperial Airways, as a cursory glance at the facilities the steward has in his pantry does not appear to offer any solution. The fact remains, however, that when they do give their passengers anything hot it is really hot. The luncheon was served directly after the *Scipio* had taken off from Corfu, where a landing had been made for

fuel. Capt. Bailey, who, as do all Imperial Airways "skippers," makes a personal matter of the comfort of his passengers, went back into the cabin on several occasions, and after cutting a cake, which had also been provided, presented the diaries from the tree.

Despite the fact that only one steward is carried, there were no undue delays, and the whole of the service was carried through very smoothly indeed. As a matter of fact, the steward in an Imperial Airways liner has in some ways an easier job than has the attendant in a railway train, as more often than not he is able to walk about with his dishes without being in danger of being crashed from side to side at every other step. In a train, however, there is a comparatively large staff, but Imperial Airways manage their excellent service in these flying boats with but one steward, it sounds a lot for one man to do but he manages very efficiently indeed.

A MIDLAND & SCOTTISH SUBSIDIARY

It was learned in Dublin recently that proposals, originating from Midland & Scottish Air Ferries, have been submitted to the Free State Minister for Industry and Commerce (Mr. Sean Lemass) for the formation of an Irish company to operate the Dublin-Cork section of the service which the Scottish company proposes to run from Hooton in the near future. Representatives of the company interviewed the Minister on this question some time ago, so it is not likely that he will raise any objections to their proposals.

THE EAST INDIAN AIR ROUTE

In a speech at Rotterdam last week Mr. Hans Martin, director of the K.L.M. East Indian service, spoke of the future development of the aerial connection between Holland and her East Indian possessions in the light of the recent flights of the *Pelikaan* and the *Postjager*. With the completion of the Fokker F.XXXVI, he said, the K.L.M. will have an aeroplane capable of carrying 16 passengers to Batavia and back in six days. Meanwhile, both England and France are organising their own services over the same route, and it is possible that in a not very far distant future all three national companies will be in a position to operate a twice-weekly service to the Far East. With a little co-operation an "international" daily service, each company sending an aeroplane every fourth day, could be brought into existence. In the meantime there was much to be done in equipping aerodromes along the common route with the necessary "furnishings," hangars, fuel tanks, radio signals, and the like. The *Pelikaan* flight had

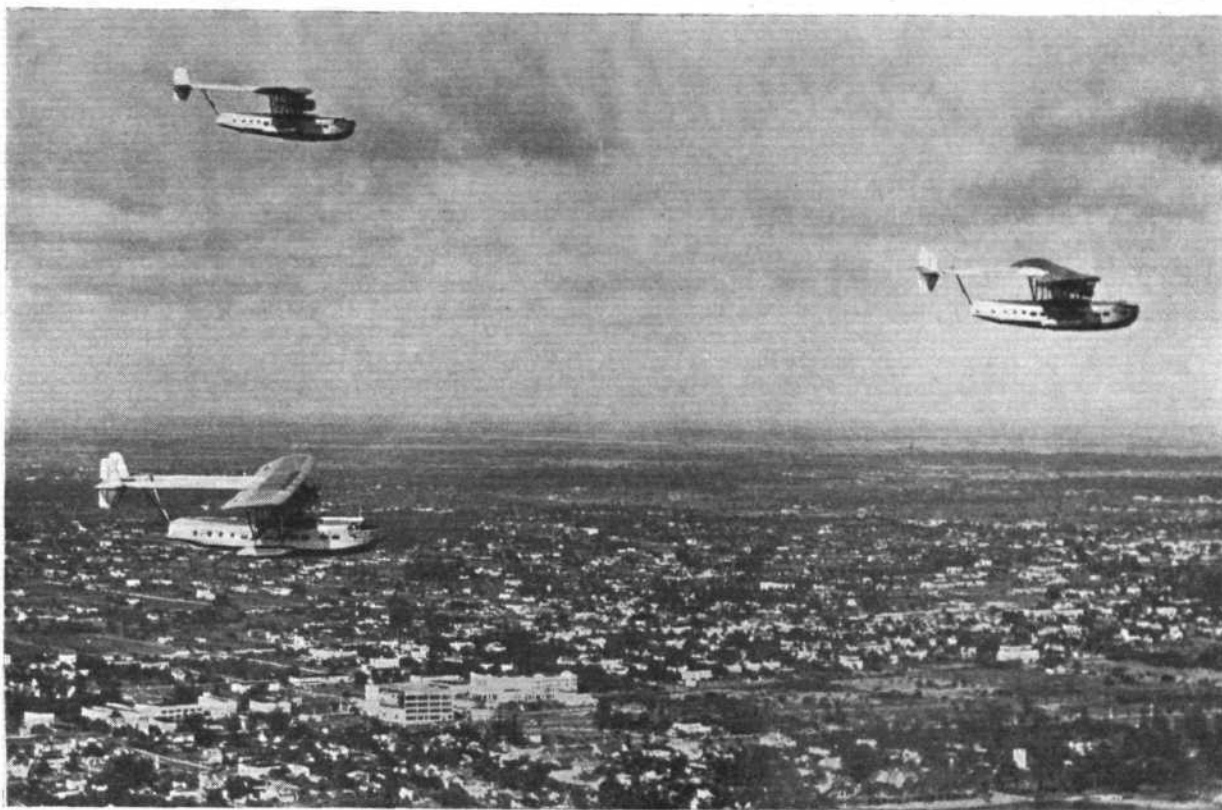
shown that long-distance night flying was practicable. With the Fokker F.XXXVI the K.L.M. would be able to carry night flying a stage further. They were confident, too, that the number of passengers would increase, and so enable them to lower the postage tariff, which was the main object in view.

A MATTER OF NATIONALITY

By one of those curious slips of the pen, we stated in our report last week of Sir Charles Kingsford's flight across the Tasman sea that the *Southern Cross* was a German machine. This machine, of course, is a Fokker, of Dutch construction, not German.

THE LZ-129

It is probable that the new Zeppelin, LZ-129, which is nearing completion, and which, it is claimed, will be the largest airship in the world, will be tested on the South Atlantic route during the late summer of this year. The airship will operate the Europe-South America service with the *Graf Zeppelin*, working during the winter months when the smaller ship is laid up for her annual overhaul. The LZ-129 will carry 50 passengers (twice as many as the *Graf Zeppelin*), a crew of 35 and 10 tons of mail or freight. The main dimensions are: length 812 ft. and height, including gondola, 145 ft. The nominal gas volume will be 6,720,000 cu. ft. Two promenade decks, 25 staterooms and a smoking room are some of the features which will make the new Zeppelin more comfortable for the passengers than the older type. Four 1,200-h.p. Maybach heavy-oil engines will be fitted. Up to the present, Ludwig Duerr, the designer, has not decided on the gas to be used.



MODERN LINKS OF TRADE BETWEEN THE AMERICAS : Three of the large Sikorsky S-40 airlines of Pan American Airways flying over Miami. These machines, carrying 40 passengers each, are used for operating a daily service between Miami and various parts of South America.

Owing to the cost of helium, it is possible that he may use hydrogen with a covering of helium, making provision for the escape of the hydrogen when there is danger from fire. A special aluminium paint will be used on the envelope to counteract the heating effect of the sun.

K.L.M. IN ITALY

THE Italian Air Ministry has decided to allow K.L.M. to make Rome a stopping place for aircraft on the Amsterdam-Batavia route. The company will now operate air mail and freight services to and from Rome, but will not compete with the Italian airlines to Athens (A.E.I.) and Marseilles (S.A.N.A.).

THE SABENA CONGO SERVICES

THE Port Francqui-Lusambo route (296 miles), which is an extension of the Leopoldville-Port Francqui airway, is now once more being operated by Sabena. Operations were resumed on January 5. Triple-engined Fokkers are used on this section for twice-monthly services in each direction.

AIR TRANSPORT IN GERMANY

THE aims of Deutsche Luft Hansa during 1934 will be as follow:—(1) Fewer flying hours by operating faster types of aircraft (particularly Junkers Ju 52/3m's); (2) the operation of "express" routes, using high-speed aircraft (Heinkel He.70 and Junkers); (3) development of night air mail connections; (4) multiplication of the airlines operated on behalf of the Deutsche Reichsbahn (German Railways); (5) opening of the first German airways operated several times a day, and (6) the development and maintenance of the postal service to South America. According to recent figures, Germany now has 20 airports equipped for night-flying air traffic. These are Aachen (Aix la Chapelle), Berlin, Bonn, Braunschweig (Brunswick), Darmstadt, Hannover, Düsseldorf, Essen, Frankfurt, Dortmund, Köln (Cologne), Königsberg, Nurnberg, Lübeck-Travemünde, Hamburg, Mannheim, Stuttgart, München (Munich) and Stolp.

BETTER FIGURES FOR K.N.I.L.M.

THE monthly report of the Royal Dutch East Indian Air Lines (K.N.I.L.M.) for November, 1933, shows improved figures over those for October, especially on the Medan and Singapore routes. The month's total was 1,359 passengers, 5,341 kg. freight and 2,222 kg. post. The busiest routes were Batavia-Bandoeng with 367 passengers and Batavia-Sourabaya with 235. November 7 saw the official opening of the flying field at Djambi, when over 150 people took the opportunity to have "joy trips." The

Sultan of Kedah and members of his family made a trip from Alor Star in a K.N.I.L.M. machine to view the Sultan's territories from the air. To avoid delaying the mails, the K.N.I.L.M. have introduced a special winter connection with the K.L.M. at Batavia, where the European mail arrives on Saturdays, to Semarang, Tjepoe and Sourabaya.

S.A.N.A. FIGURES

THE following are the traffic figures for 1933 obtained by the Società Anonima Nord Africa Aviazione, which operates the Bengasi-Tobruk and Tripoli-Bengasi services:—191,500 miles flown, 2,013 flying hours, 3,199 passengers and 25,800 lb. of mails. There were no injuries to passengers, personnel or goods.

THE STOCKHOLM-HELSINGFORS SERVICE

THE A.B. Aerotransport Company, which ceased operation on the Stockholm-Helsingfors connection on December 12 until April 15 this year, had to work under very difficult conditions during the latter part of last year. The machines used are Junkers Ju52/3m seaplanes fitted with "Hornet" engines. Owing to the temperature—10 degrees Centigrade which prevails in the district, an ice breaker had to be used every morning to clear a channel through the ice so that the big Junkers could taxi out behind it with its load of passengers into the warm stream which was not frozen over, and where the machine could take off. We give below the traffic figures for the line during the past year together with those for 1932 for comparison:—

	Flying hours	Passengers	Air Mail (lb.)	Baggage (lb.)	Freight (lb.)
1933	1,071	4,385	54,264	138,473	43,590
1932	1,046	3,128	44,989	100,879	27,689

EUROPEAN INTEREST IN AMERICAN AIRCRAFT

As we have previously recorded, Mr. Balz Zimmerman has been in the United States to buy new machines for "Swissair." Mr. Zimmerman is now back in Europe. Some while back it was rumoured that "Swissair" had ordered a Douglas "Airliner" and a Lockheed "Electra," but it now seems that this rumour was incorrect. A Clark GA-43, however, will soon arrive in Europe, and will start operation on the Swiss services in the spring. M. Paul-Louis Weiller and Mr. Anthony Fokker are also to visit America in the near future; M. Weiller intends to study aeronautical developments.

From the Clubs.

HANWORTH (N.F.S.)

In spite of the high winds that prevailed during the week, 48 hr. were flown on Club aircraft. Mr. Kirwan carried out two further tests for his "B" licence, and on Monday, January 15, Mr. Ramsay returned from his cross-country flight to Thornby. On Friday, January 19, Mr. Llewellyn flew a photographer to Southampton to photograph the *Majestic* as she sailed into the new King George V Dock. On the same evening pupils in training for "B" licences were given instruction in night flying, after which a parachute drop was done by Mr. George. The aerodrome was lit with night-flying lighting equipment and Mr. George himself was wearing a belt and armlets of electric lights, which he switched on as he jumped from the machine, effectively illuminating the ground as he alighted. Members are advised to book tables early for the dinner and dance which is to be held at the clubhouse on Saturday, January 27.

THE YORKSHIRE AEROPLANE CLUB

High winds kept flying time down to 5 hr. for the past week, including flights to and from Birmingham by Mr. R. E. Beanlands. A new member is Mr. E. G. Rycroft. The children's fancy dress party on January 13 was a great success, prizes being won by Miss J. Hickson, Messrs. A. G. Mackenzie, R. B. Mackenzie and I. D. M. Mackenzie. The final of the Grimthorpe Trophy was flown off on Sunday, January 14, the winner being Mr. J. R. Micklethwait, a private owner, Dr. H. W. Morck being second. Lord Grimthorpe's Cup is awarded annually for the best performance in general airmanship by a club member. The test consists of a triangular course of about 120 miles. Each competitor is required to prepare his own machine for flight, work out his route, and execute two forced landings. He is also accompanied by an instructor, who flies as passenger.

LEICESTERSHIRE AERO CLUB

The Annual Meeting of the Leicestershire Aero Club will be held on Wednesday, January 31, at the Oriental Hall, Market Place, Leicester. It will be preceded by a lunch, presided over by the President, Mr. Lindsay Everard, M.P. The price of the luncheon is 3s., to be paid on attendance. The Annual Meeting will start at 1.45 p.m. and terminate at 2.30 p.m.

BROOKLANDS

Owing to gales and heavy rain only 21 hr. dual and 14 hr. solo flying has been carried out during the past week. A farewell party is being held at the club on Sunday, January 28, to Mr. S. A. Thorn, who will be leaving Brooklands shortly to take up an appointment with Messrs. Henlys & Birkett in the Midlands. Mr. Lowdell and Capt. Duncan Davis have been busy working out a special comprehensive "B" licence course which will include much more practical engineering. The General Meeting of Brooklands Aviation was held on Saturday, January 20, and another small dividend was declared by the Chairman, Mr. F. Sigrist. The new flying badges for flying members of the Northampton, Lympe and Brooklands Clubs are now ready for issue. These badges will entitle the owners to free admission to Brooklands and Northampton, and free landings at Lympe, with the exception of clearing Customs inwards from the Continent. New members during the week were Messrs. Harrison and Duraiswami. Mr. Addinsell successfully carried out one of his "B" licence cross-country tests, and other cross-country flights were made to Penshurst, Lympe, Gatwick and Brough. The General Meeting of the Aero Club will be held on Saturday, January 27, at 6.30 p.m., and will be followed by the opening of the new bar.

HATFIELD

The week's flying times for the London Aeroplane Club amounted to 33 hr. Among new members, the Club have pleasure in welcoming Messrs. J. G. Campbell and A. J. Edmunds. The following members have been elected to serve on the committee during the year 1934: Maj. K. M. Beaumont, Capt. A. G. Lamplugh, Messrs. R. M. Clarkson, G. H. Craigh, Will Hay, B. H. Marriage, R. C. Presland and E. E. Stammers. The flying times for the R.A.F. Reserve totalled 6 hr. 10 min., ten officers being in residence. The R.A.F. Reserve Flying Club flew 3 hr. 30 min. and have now purchased another "Gipsy I Moth." Many private owners took advantage of the fine

weather over the week-end; among them were Sir Derwent Hall-Caine, who flew his "Leopard Moth," Mr. Place, who have just taken over a "Gipsy Moth," and Lady Loch. During the week a "Puss Moth," a Miles "Hawk," a "Martlett," five "Gipsy Moths," a "Bulldog" and two "Leopard Moths" visited the aerodrome. The "Leopard Moth" G-ACHD, winner of the King's Cup, has been carrying out experimental flights during the week.

NEWCASTLE AERO CLUB

The Club annual dinner and dance was held on Friday evening, January 19, at Tilley's Barras Bridge Assembly Rooms. There were approximately 200 guests, and everyone spent a very enjoyable evening. The guests of the evening were:—The Lord Mayor and Lady Mayoress of Newcastle, Sheriff and Sheriff's Lady of Newcastle, Mr. J. A. Mollison, Mr. W. Courtenay, Sqd. Ldr. R. A. Deacon and Mrs. Deacon. Mr. Mollison flew up to Cramlington from London on Friday morning in his "Dragon Moth" *Seafarer II*.

Total flying time for week ending January 21, 22 hr.

READING AERO CLUB

The Club's annual "At Home" has been fixed for Saturday, June 9. The weather has been good during the week-end and the School has been very busy, the "Martlet" being in great demand.

THE NORFOLK AND NORWICH AERO CLUB

There were three very windy days during last week, but the week-end made up for them. Miss S. Bagge and Mr. G. R. F. Clarke received instruction from Mr. J. Collier, and Lady Hare, Miss N. Bagge, and Mr. A. R. Cox took short refresher flights. Solo flights were done by Miss W. F. Hudd, Messrs. A. R. Kirkby, A. J. Morris, S. Hansel, H. C. Stringer, A. J. Sayer and F. W. Rushmer. Another visit was received from Capt. A. M. Diamant, who flew from Manchester in his "Puss Moth," and Mr. and Mrs. S. Turner flew over from Croydon in their Avro "Cadet." On Saturday Mr. A. J. Morris gave a talk on Aviation to the members of the Y.M.C.A. in St. Giles', which was well attended. The Club have gained ten new Associate members during the week, and to encourage these to bring their friends to the Club, Thursday, January 25, will be a Visitors' Night, and if sufficiently well attended this will become a regular weekly feature.

THE EAST ANGLIAN AERO CLUB

It is proposed to hold a dinner and dance at the Holborn Restaurant on Wednesday, January 31, and the Club hope that their President, Sir Claude Champion de Crespigny, will be able to attend. The success of this, the Club's first dinner dance, depends on the support given to it by members. The price of the tickets will be 12s. 6d., which will include dinner, dance and cabaret.

LIVERPOOL AND DISTRICT AERO CLUB

High winds and rain have restricted flying during the past week and only 4 hr. 5 min. dual, 8 hr. 15 min. solo and 20 min. tests have been flown.

NORTHAMPTONSHIRE AERO CLUB

Work on the new aerodrome buildings is rapidly nearing completion. The roof is on the clubhouse, and the erection of the hangars should be completed by the end of next month. Flying, during the last week, has been seriously hindered by the weather. Mr. Geoffrey Linell has bought a "Hermes Avian." Recent visitors by air included Capt. Duncan Davis, Messrs. Marc Diamant, P. Cubitt, Hanstock, Shuttleworth, Whittome, Wal Handley, the racing motor cyclist, and six machines from the Leicester Club. The next party, possibly the last in the old clubhouse, will be held on Friday, January 26. Members will attend as savages of any nationality.

BENGAL FLYING CLUB

The flying times of the Bengal Flying Club for the month of December totalled 78 hr. 40 min. dual and 130 hr. 35 min. solo. The Club has had three machines in use and three privately-owned machines. The total membership of the Club is 359. First solos have been done by Messrs. A. Roy, W. G. Robinson and A. K. Chakravarty, and "A" licence tests passed by Messrs. A. C. Watkins and A. K. Chakravarty. There has been one cross-country flight to Midnapore and back. Three machines took part in the Proclamation Parade, flown by F/O's K. D. Knocker, the instructor, M. C. R. Harris and Mr. H. I. Matthews.

The AIRCRAFT ENGINEER

"FLIGHT" ENGINEERING SECTION

Edited by C. M. POULSEN

January 25, 1934

CONTENTS

	Page
Ethyl. By F. R. Banks, O.B.E., F.R.Ae.S., M.I.A.E., M.Inst.P.T., M.S.A.E. ...	1
In the Drawing Office—	
Laying out Lines and Plating. By R. Haley ...	5
Hyduminium R.R.53 B ...	8
Power curves of De Havilland "Gipsy Six" engine ...	8

ETHYL

By F. R. BANKS, O.B.E., F.R.Ae.S., M.I.A.E.,
M.Inst.P.T., M.S.A.E.

The paper on "Ethyl," read by Mr. Banks to the Royal Aeronautical Society on January 18, presents some difficulty to a paper like FLIGHT, in that its importance, in view of the Air Ministry's decision to use leaded fuel in the future, is such that it ought to be published in full. Space does not, however, permit of this course being taken, and we have decided to publish a summary of the first part of Mr. Banks' paper in the FLIGHT pages this week. The second, and more technical, part of the paper is summarised below, but will take one or two more instalments to complete.—Ed.

ENGINE DEVELOPMENT

Some information indicating the lines to follow in order to make full use of fuels containing lead

THE manner in which leaded fuels have been viewed, in some quarters, is extraordinary. If the same difficulties had been put in the way of the development of superchargers in this country, one is certain that they would not yet be in use except in a very experimental way, and in consequence we would not have been in the position to produce some of the world's best aviation engines, as we are doing to-day.

With regard to the employment of high Octane fuels in America, while a large amount of test bench work was, and still is, being done, they appreciated the necessity of obtaining practical flight experience in the early stages of development and took the view that whatever the results of bench tests, they would probably come up against sundry difficulties in actual service, so the sooner experience was gained, the better. We, in this country, have admittedly obtained valuable data from the test bed during the past two years or so, particularly on leaded fuels, but little data has been obtained on fuels of high Octane value and the operation of high duty engines in actual service.

The problem of the operation of aviation engines on any fuel, because of their relatively high specific power output, is quite peculiar to their class and cannot be compared with the normal operation of automobile

engines, with which little or no trouble is now experienced over long periods of use. The aviation engine has to deal *continuously* with a far greater *bulk* of heat per unit volume of cylinder than practically any other petrol engine. It is, therefore, more difficult to obtain reliability over long periods of service without paying greater attention to it between times. Such items as the pistons and valves are very much larger than those in normal automobile engines, and it is, therefore, difficult to arrange the design of these parts so that they are able to dispose of the heat satisfactorily and still retain their form and material structure. Modern engine development, therefore, demands what may be called at the present time "super fuels," although in five or ten years' time these will probably be considered mediocre.

The Effect of the Products of Combustion of a Leaded Fuel upon the Engine Parts

The main products of the combustion of a leaded fuel with which we are concerned is lead bromide. Under particular circumstances, the presence of lead bromide may aggravate certain troubles which, previously, might have been latent in the engine, with the possible exception of one, namely, cold corrosion. The weak links in the chain connecting satisfactory engine performance with leaded fuel are as follows:—

- The tendency of the exhaust valve to scale and burn, due to "hot" corrosion attack of the valve seat and insert, and/or "mechanical" attack by the pieces of detached scale.
- "Cold" corrosion attack of the exhaust valve stems, when the engine is standing idle.
- "Cold" corrosion of the cylinder bores under the same conditions as in (b).
- Corrosion attack of the exhaust pipes and collector rings.
- Deposition of lead salts on the sparking plugs.

This list appears formidable, but with the materials available to-day, coupled with suitable design, there is no need for these troubles to persist.

Exhaust Valves and Valve Seat Inserts, General Considerations

The exhaust valve is undoubtedly the most vulnerable part of an engine, since it must perform well at elevated temperatures (around 800 deg. C.) when working without undue scaling or becoming mechanically weakened and, in addition, remaining gastight.

In the case of an exhaust valve which works in the presence of leaded fuel, a hard, black, polished and

THE AIRCRAFT ENGINEER

adherent skin generally appears to form on the seat surface in the early stages of running. It is not yet clear whether this skin is a lead product deposited on the seat surface, or is a result of corrosion attack of the material itself. One is, however, inclined to the former theory, that it is in the nature of a glaze, since it has also been found on valves which have operated successfully for long periods. The thickness of the glaze or skin varies somewhat, and is difficult to assess accurately, but from photomicrographs appears to be in the region of 0.0003 in. In cases where the skin has been found on valves which have operated successfully for long periods, it is of even thickness with an unbroken surface. In the case of a failure (valve burning) the trouble seems to start when the skin or glaze breaks down. The degree by which the exhaust valve, when in operation, may or may not be attacked by lead bromide is mainly controlled by its working temperature and the material used in its construction. It is one's experience that low working temperatures for the valve with a given material may cause little or no trouble, but an increase in the former may give rise to valve troubles due to failure of the material to withstand, at increased temperature, the lead bromide attack, and it will then scale and perhaps burn. To eliminate these troubles at the outset, the broad principle is to ensure by suitable design that the working temperature of the exhaust valve will be kept to an absolute minimum and a valve material chosen which, in addition to high mechanical strength and durability at elevated temperatures, will have a good resistance to attack by the exhaust products.

The experience we have in this country, and on the Continent, seems to indicate that the valve seatings in the cylinders themselves exercise a considerable influence upon the conditions of the seat of the valve and therefore, the life and behaviour of the latter. In this connection it is interesting to note that the question of the conductivity factor of the seat insert material appears to be of secondary importance and, provided that the coefficient of expansion of the material is as near as possible to that of the cylinder head material in which it is fitted and the method of fitting satisfactory, i.e., good thermal contact maintained, its capacity for getting rid of heat is much greater than the amount of heat which the valve can give up to it. The important features which a valve seat insert should possess are: a high resistance to corrosion attack and good surface hardness, or, in any case, toughness. Corrosion resistance appears to be the principal answer to valve-burning troubles and, in addition, the provision of a hardened surface in one or both cases seems to prevent abrasion of the seat surfaces by any scale which would tend to spoil the thermal contact between the valve and its insert.

The rate of development of the modern aviation engine is such that great difficulty is being experienced in keeping the exhaust valve temperature within reasonable limits. It has been apparent during the last year or so that however efficient the design of the valves and seat inserts, it is difficult, if not impossible, to get rid of the heat adequately in this manner. Obviously, the hotter the exhaust valve the more limited are the capabilities of the engine with fuels of given Octane value. This has led to the development of the internally-cooled valve, which is one having a hollow stem, and sometimes head, partially filled with a medium, usually metallic sodium, which will efficiently transfer some of the heat from the valve head to the cooling medium of the engine (air or liquid) via the valve stem and guide.

Suitable Valve and Insert Materials and Combinations

The material most generally used up to the present time, for inserts, is aluminium bronze. This is still used, but it will, undoubtedly, be superseded by the special alloy steels. These steels are already being tried,

and, in fact, one or two manufacturers have done a considerable amount of running with steel inserts and intend to standardise them in all their future models. The materials generally favoured are those of the semi-austenitic or austenitic variety, and in some cases are similar to those used for the valves themselves. These steels generally have a good resistance to corrosion and scaling at high temperatures, and there are some particular brands which are exceedingly tough and "work harden" to a high degree. Notable among these is N.M.C. (nickel, manganese, chromium), a high-expansion steel produced by Firth's. This steel has a coefficient of expansion which lies between that of aluminium bronze and the aluminium alloys generally used for cylinder head material, being 0.0000223 between 200 and 300 deg. C.

It is extraordinary how a change in insert material affects the valve. Many cases have come to one's notice where valves have burned when operating against aluminium bronze inserts and have been completely cured on going over to steel inserts. The following combinations could, in the light of recent experience, be tried with advantage:—

- A valve of austenitic steel working against an insert of similar material or N.M.C., preferably the latter.
- A similar type of valve as in (a) "Stellited" on the seat and working against insert material which is not "Stellited."
- Both the valve and insert "Stellited," using the same materials as in (a).
- An un-"Stellited" valve against a "Stellited" insert, similar materials used as in (a).

In the case of (a), K.E. 965 valves have been tried with success on prolonged tests against inserts of N.M.C., both on complete air-cooled engines and single cylinders of the same type.

Some Notes and General Information on the Valve and Insert Design, Construction and Fitting

The following deals with the sodium-cooled valve and steel insert, because it is felt that this combination is a direct line of development to pursue immediately.

Valves

In Fig. 8 sketches are shown of the sections of two sodium-cooled valves differing in design.

(a) shows the latest type of sodium-cooled valve developed in America. The hollow forged head should be noted, together with the swaged-in hollow plug or thimble at the stem end. The latter is to prevent excess heat from travelling up to the stem end upon which the valve rockers operate, particularly in the case of the

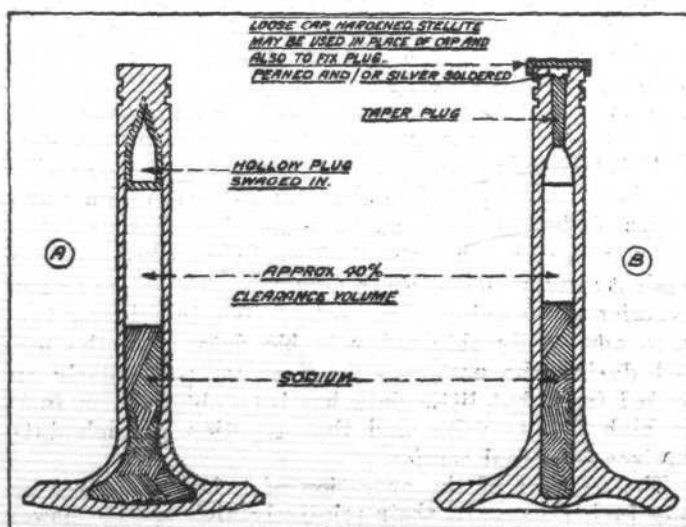


Fig 8.—Typical examples of sodium-filled valves

THE AIRCRAFT ENGINEER

partially lubricated valve gears of air-cooled engines, where there is a risk of excessive heat getting to the valve springs and softening them.

(b) gives a sketch of a similar valve with a hollow stem only, and it shows a different method of plugging which is also in use. The taper plug is pushed in, and the material peened over it at the stem end. A loose, hardened cap is then fitted over the stem end, or a hardened tungsten-steel button welded on. Quite a good idea is to "Stellite" over the stem end, and this will ensure that the plugging remains tight and provides something of suitable hardness upon which the rockers can operate directly. The valve is of the modified tulip type. The full tulip head is not desirable since, due to its greater exposed surface, it usually runs hotter than the other types, and in any case the sodium is too far

properly and cause valve burning. Distortion is very difficult to detect or control, but if valve burning is experienced, this possibility should be the first to be investigated. The rim of the valve, and the insert, should be regarded as two concentric rings, and both designed to achieve this effect in practice. The design of the valve guide for a sodium-cooled valve is very important, because the stem has to deal with extra heat, and unless it can get rid of it to the cooling medium in an efficient manner, a high degree of guide wear will result.

Fig. 9 gives rough sketches of different types of inserts and the methods of fitting them. The shrunk screwed insert is in general use in this country, whereas in America the plain shrunk type is practically universal. Further details will be found in the main text.

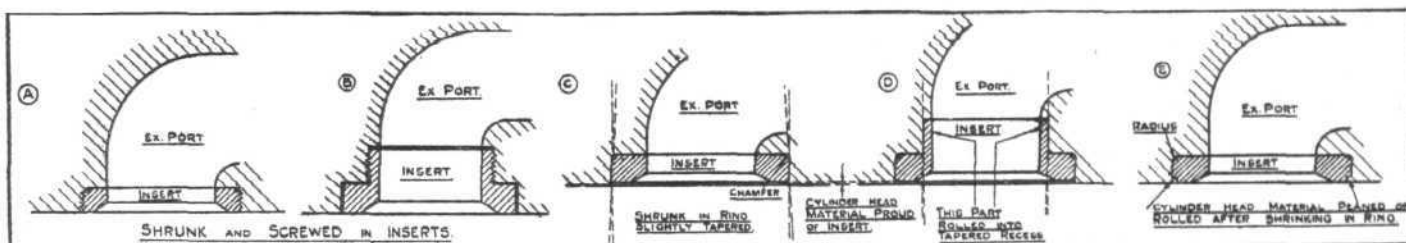


Fig. 9—Various methods of fitting valve seat inserts. The screwed type is in general use in England while the plain type is almost universal in America

removed from effective contact with most of the head material.

The most effective valve seat angle is, in my opinion, one of 30 deg. This gives a better average valve opening characteristic than, say, one of 45 deg., but it is more difficult to ensure maintaining a satisfactory seating with this than with one to the latter angle, and, perhaps, in the case of an exhaust valve, particularly, it is more important to ensure that the valve seats itself efficiently rather than to benefit by the small increase in porting efficiency offered by the former angle.

The question regarding the most satisfactory width of valve seat to employ is a vexed one. For some time, the American engine firms have favoured a relatively wide seat, and in some cases the seat widths have been somewhat excessive. The tendency in the States now appears to be towards a narrower seat, particularly for engines of high specific power output using fuels containing lead. The seat widths of some typical American valves range from $\frac{3}{32}$ in. to $\frac{1}{4}$ in. for a large valve having a seat diameter of about 3 in. and from $\frac{1}{8}$ in. to $\frac{3}{16}$ in. for valves of 1.75 in. to 2 in. seat diameter. The British engines generally keep to the lower limits of the widths mentioned, and in some cases are only half the width, in proportion. One hesitates to speak of "wide" or "narrow" seats as such, and considers that the question of width is really a compromise which is controlled by the considerations of individual engine design. Satisfactory unit loading, to achieve good thermal contact, should be considered of primary importance. There is a risk, if the seat is very narrow, that any "blow past" which may occur will cause "guttering" right across the seat, whereas with a wider seat, under similar conditions, it usually takes longer for this to occur, and it may only show up in the form of pitting. It will be appreciated, therefore, that it is unwise to dogmatise on such matters.

Many valve troubles are occasioned by distortion of the cylinder head. This is particularly liable in the case of the monobloc arrangement used for the large modern liquid-cooled engines, and it has also been the cause of a large amount of trouble in some ordinary motor-car engines. Distortion, so far as it may affect the valve, generally causes misalignment between the valve guides and inserts, or actual "ovalising" of the latter, both of which prevent the valves from seating

"Cold" Corrosion

The cause of "cold" corrosion is generally accepted to be as follows: When an engine comes to rest, a certain amount of condensation takes place, particularly in the case of a cylinder in which the exhaust valve has stopped in the open position. Any lead bromide present will also condense, and this, with the moisture present, gives rise to corrosive action, particularly on steel parts. The principal points attacked by "cold" corrosion are the exhaust valve stems and the cylinder barrels. The extent to which they are attacked is influenced by the materials used, and also the working conditions. The general treatment, to avoid attack, is to ensure that the parts concerned are well covered by a film of mineral lubricant. Further details concerning particular treatment will be found in the main text.

The use of "nitriding" in this connection has been quoted, but our experience here and in Europe seems to indicate that, so long as the parts made from these materials are kept well lubricated, little or no trouble is encountered. Adequate lubrication is naturally quite possible with, say, cylinder barrels, but the use of completely nitrided exhaust valves is not recommended, although the valve stems may be treated in this manner and are quite satisfactory so long as the nitriding is not carried too far down to the hot part of the stem.

Exhaust Pipes and Collector Rings

The usual material employed in the construction of exhaust manifolds is mild steel, which after forming is welded and riveted. Mild steel, although fairly satisfactory, is not the best all-round material to use, and is very prone to split, due to a combination of temperature variation and vibration, which cause fatigue of the material. Steels of the stainless and/or austenitic variety are gradually coming into use, particularly in America. These are corrosion resistant to a high degree and do not scale easily. Exhaust collector rings of stainless steel are, one understands, very generally used by the military machines in the U.S.A. The use of mild steel rings has been general with the civil aircraft operating concerns in the States, and although no great trouble was experienced from their continued use in conjunction with that of leaded fuels, it is understood that they are being replaced with stainless steel rings as occasion permits.

Sparking Plugs

There is no more difficulty in obtaining a suitable plug for operation with leaded fuel than choosing one for any engine whatever the fuel used. In either case a satisfactory choice largely resolves itself into a matter of practical test. The three troubles which may possibly occur are (1) an excessive rate of build up of deposit on the insulator; (2) possible breakdown of the

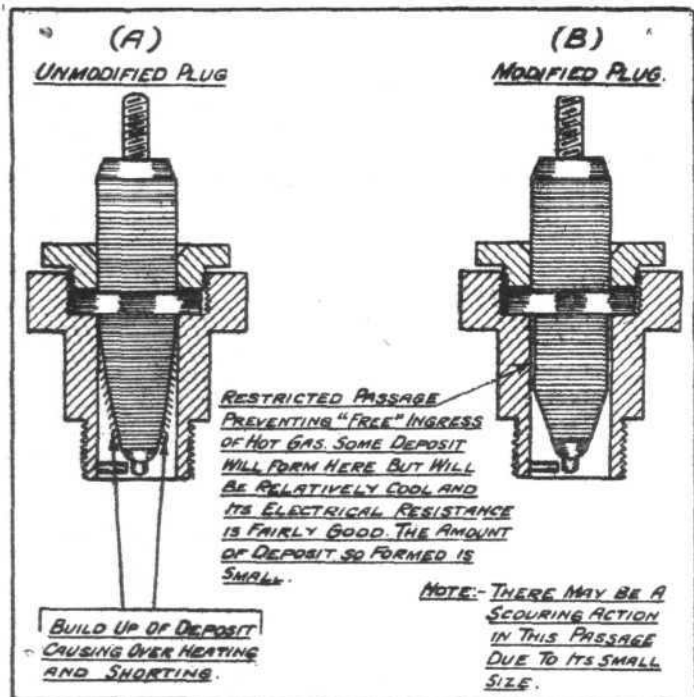


Fig. 10—This sketch shows modifications made to mica sparking plugs to suit air-cooled engines using a "leaded" fuel.

insulation; and (3) erosion or corrosion of the electrode tip. These are not necessarily related, and are differently influenced by temperature. More complete details will be found in the main text, but let it be said that any troubles experienced with sparking plugs are not critical, and the cures are relatively straightforward.

Some Notes on "Stelliting"

Although in use for some time, the application of Stellite to the valve and seat inserts of aviation engines is only a relatively recent development, consequently the following information may be of some assistance. "Stellite" is a material composed largely of cobalt and chromium, between 50-65 per cent. of the former and 30 per cent. of the latter, together with tungsten, which may vary, in proportion, from about 4 to 20 per

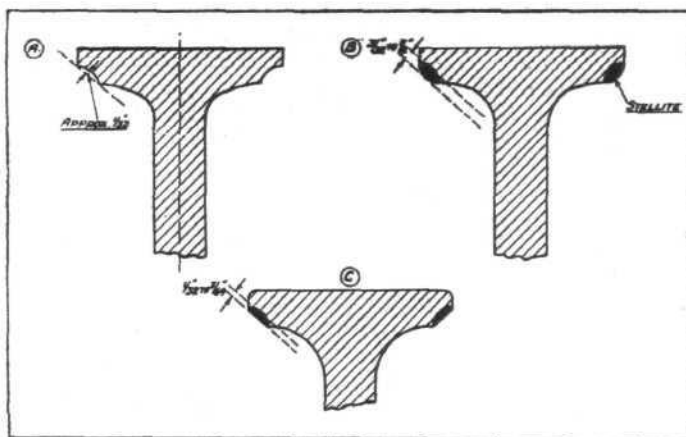
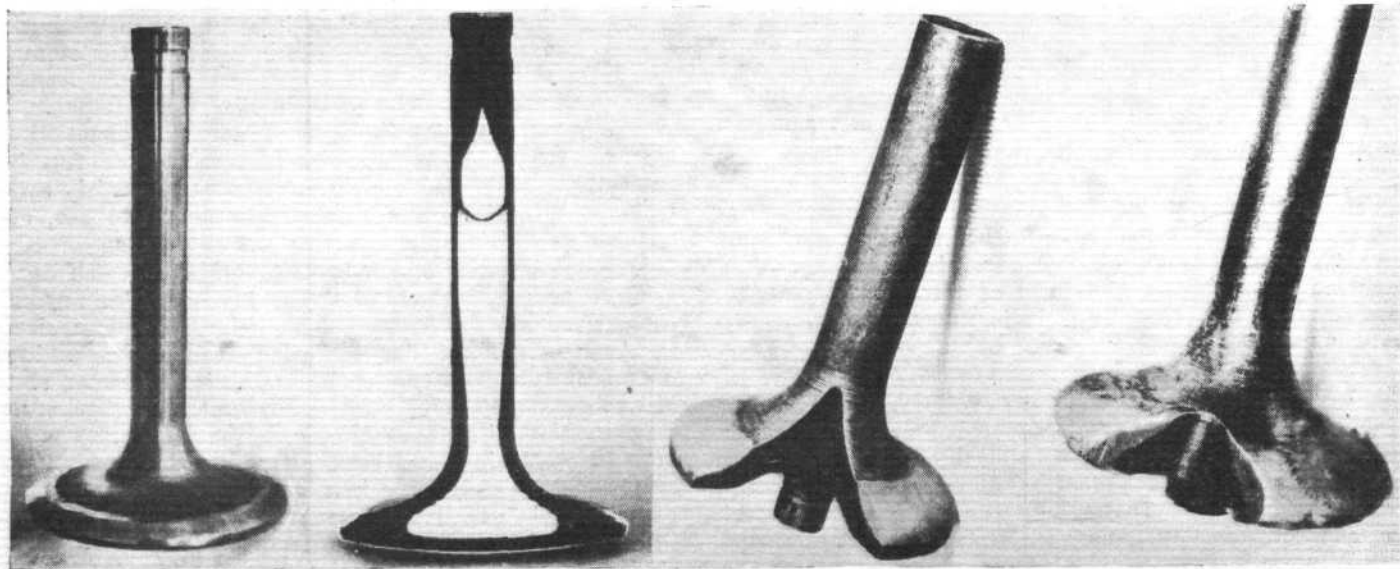


Fig. 11—This diagram shows the various stages of stelliting a valve seat.

cent. The amounts of the constituents vary according to the particular grade and degree of hardness required. Both at low and elevated temperatures its resistance to wear and oxidation is excellent. It is particularly effective in resisting, at high temperatures, corrosion attack by lead bromide or the products of its decomposition. The treatment of valves and inserts consists, briefly, of applying a layer of "Stellite" to the seat surfaces, this being done by means of an oxy-acetylene torch. "Stelliting" is not, actually, a welding process, since fusion of the Stellite and the material of the part being treated, is not desired. It might be described as a high-temperature brazing process. A description of the technique of applying Stellite will be found in the main text. The figures 11 to 15, however, show the essential points in the process.

Fig. 12 shows a typical example of an exhaust valve of a large American radial engine. The valve has a hollow forged head, sodium filled, and both the seating and valve head are Stellite. This valve measures about 3 in. across the outer diameter of the seating and weighs approximately one pound in its completed form. Fig. 13 gives a sectional view of the same valve. Note the hollow swaged in plug at the stem end, and also the thickening up of the stem section at the neck. This valve is a remarkable example of accurate forging. The illustration in Fig. 14 shows Stellite deposited on a rough machined valve of martensitic steel. The segment cut from the valve head shows up the section. Fig. 15 shows a valve of the same type as Fig. 14, but it is of austenitic steel similar to K.E. 965, and is the product of another manufacturer. Note the difference in the Stelliting.

(To be continued.)



Figs. 12 to 15—Show further details of different valve types and methods of "stelliting."

THE AIRCRAFT ENGINEER

IN THE DRAWING OFFICE

LAYING OUT LINES AND PLATING

By R. HALEY.

In getting out a set of lines for either an ordinary "fairing," drawing, or plating up a monocoque fuselage, it is impossible to get them correct unless they are faired in three views; putting a line in "to eye" is hopeless. Only a few years ago, when 90 per cent. of the fuselage fairings were done in wood, it was quite a common sight to see a skeleton fairing in position, with pieces glued on here, and pieces cut out there, to allow the stringers to lie fair, proving that the lines were far from accurate. Imagine plating a ship with $\frac{3}{8}$ -in. plating and the lines not being fair. No doubt this procedure was satisfactory to a degree, as when the fabric was put on the general appearance was passable, but now that we are familiar with metal monocoque fuselages the writer is of the opinion that it is worth the trouble to fair the lines properly in the first place, and eliminate any error, or endeavour to do so.

In the following article the writer will try to describe the method employed in laying out lines, half-block model, and shell expansion, for a metal fuselage. The section on lines will, of course, apply equally to a set of "fairing lines" for an ordinary fairing drawing.

Lines

To begin with, endeavour to lay out the drawing paper for the lines to as big a scale as possible, and the whole bench can, and should be, utilised, unless the machine is extremely short. A steel straight-edge, 6 ft. long, is a useful tool when laying out lines and a set of splines or battens, with at least a dozen lead weights are essential.

If time will permit, the cartridge paper should be pinned down the night before and allowed to stretch. Set down the "datum line," or "thrust line," as in Fig. 1, also centre line in plan and "body plan."

Draw in outline in profile and plan, the plan being only drawn in the bottom half of the lower drawing. Subdivide the total length between the nose and the sternpost, into an equal number of "stations" (if possible, these stations should be a multiple of the frames or fairing formers). Number these stations 0, 1, 2, 3, etc., from the left-hand side. The number of stations will depend on the total length, and whether the fuselage has a lot of curvature in its length. At the ends, especially the nose, half-stations can be inserted for fairing purposes only. Having laid out the outline in profile and half-plan, draw in the shape of the widest station (usually at half-length) on the

"body plan," to the left hand of the centre line, station 5, Fig. 1.

Next, draw lines enclosing the width and total depth on the body plan, as A, B, C, D, Fig. 1, and divide this figure into equal parts from "0," both vertical and horizontal, the horizontal lines being numbered from the base upwards, and the vertical lines numbered from the centre line to the right and left.

The horizontal planes will be known as such, and the vertical lines will be called "buttocks." Mark off the intersection of these horizontal lines with the profile and the intersection of the buttocks with the plan outline, as at "XX" and "YY," Fig. 1.

Now we are ready to transfer the height above and depth below the datum of each station to the body plan, also the half-width. Having chosen the middle station and marked same previously, mark off other stations on the body plan thus:—All stations forward of the middle station mark off to the left of the centre line of the body plan, and all stations aft of the middle station mark off to the right of the centre line.

On the body plan we now have the height and depth of each station on its centre line and the half-width along the datum about "0." These positions are "lifted" off the profile and plan with strips of paper about $\frac{1}{2}$ in. wide. Next proceed to lightly outline the shape of each station on the body plan after having noted any necessary flats that may occur, such as a bomber's window on the bottom surface, etc. The shape of the sections will otherwise be largely governed by the shape of the middle section. After all the stations and half-stations (if any) have been drawn in, proceed to draw in the diagonals as OB, OC, OA, OD, Fig. 1.

Fairing

The real "fairing" has not yet been carried out, and we now proceed to fair our "body plan."

Taking a strip of paper place same along the horizontal plane No. 1, and mark off the centre line on the strip and all the intersection points of all stations that cut this line. Transfer these points on the strip to the bottom half of the "plan" and mark off the half-width of each station. Place a batten through these points with weights thereon, and lightly draw a line through them. Proceed as above for all the horizontal planes. Do not attempt to correct shape unless there is an obvious bump, as it may be due to quite another cause. The alteration to another line later on may bring any irregular lines in the early stages to their correct spots. Now, with another strip of paper placed on Buttock No. 1, mark off the intersection of all the stations fore and aft, i.e., each side of the centre line on the "body plan." Transfer these points to the profile and mark off these points at each station. The ends of these

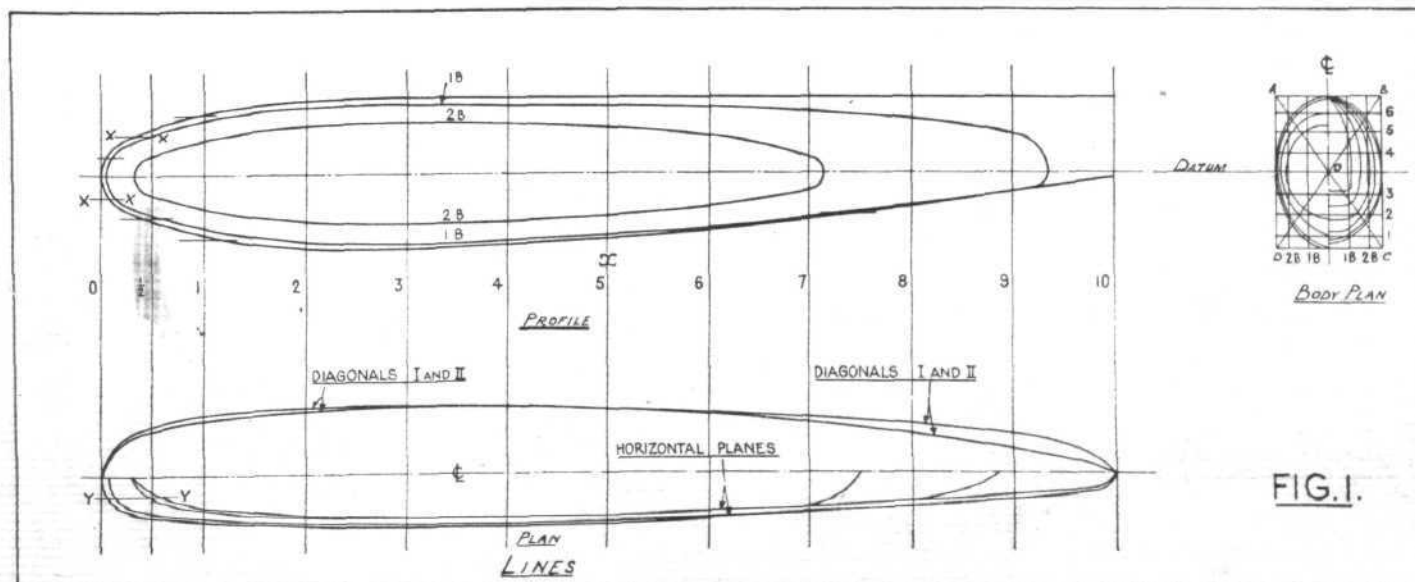


FIG. 1.

THE AIRCRAFT ENGINEER

[illegible]

buttocks will be projected from the plan as at YY, Fig. I. Carry out this procedure for all the buttocks, having lightly drawn in a line with the batten through all the points.

The third and last operation is to mark off on a fresh strip of paper the intersection of all "stations" with the diagonals. Note here that the stations forward of the middle station are taken on the line OA and the stations aft of the middle station on the line OB, Fig. 1, which is No. 1 Diag. The lines OC, OD is No. 2 Diag. Transfer these points on to the stations on the plan and mark off *above* the centre line. Other diagonals may be marked on the body plan if desired, but usually two will suffice.

We now have lines in the profile and plan representing the shape of our fuselage were it made in wood and cut through at the various horizontal planes, buttocks and diagonals. It will have been observed by now where the different lines are not fair, and the worst cases should be rectified first. Having smoothed out a particular horizontal plane in the plan, take a strip of paper, lift off the new spots for each station and transfer back to the body plan. On altering the shape in the body plan, it will be found that several other horizontal planes, buttocks and diagonals may be slightly altered and must be corrected. The whole procedure is gone over again until all lines in each view are "fair." With a little experience one is soon able to tell which line is badly out, and which to alter to avoid a lot of laborious work.

Having "faired" the lines, we now mark in the position of all frames or formers with dotted lines. A table of "offsets" can now be made up for either the stations or formers, for issue to the shops.

Shell Expansion and Half Block Model

Suppose the machine we are working on is a monocoque type, the fuselage being built up of dural plates,

on frames, the writer is of opinion that a half-block model is essential, if wastage of plate is to be avoided.

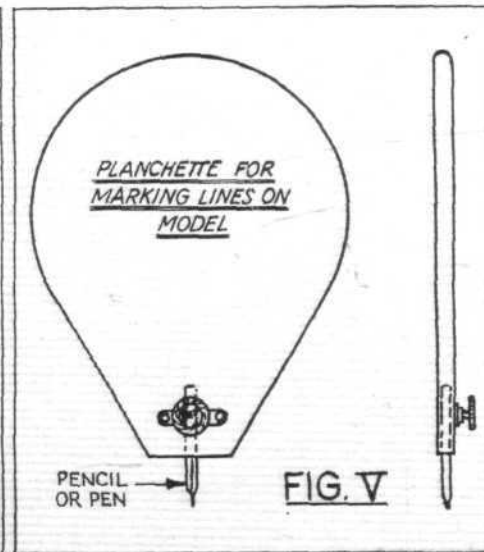
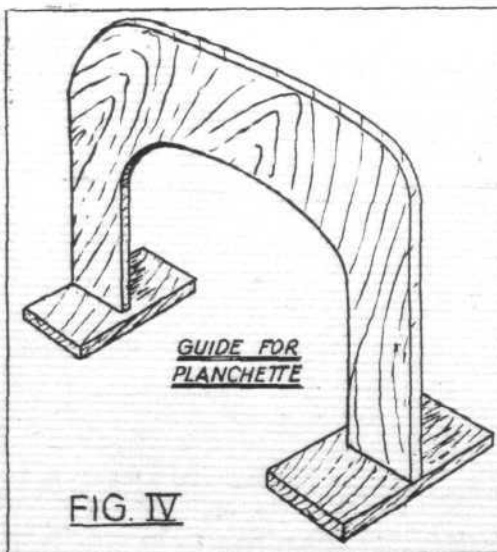
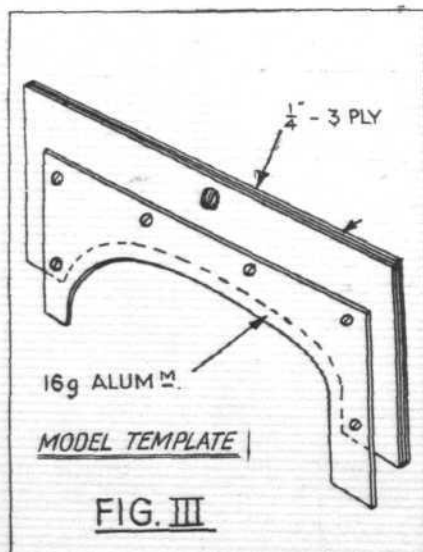
To construct a half-block model there are one or two methods of procedure. Assuming the lines have been drawn to a scale of, say, $\frac{1}{2}$ in. = 1 ft., and a print issued to the model maker. One method of making the model is to trace out the shape of each horizontal plane on tracing paper, place same on a suitable piece of soft wood of the same thickness as the distance apart of these planes and prick the outline through on to the wood. Shape each layer of wood to the marks, and when all are finished glue same together and clamp up until glue has set.

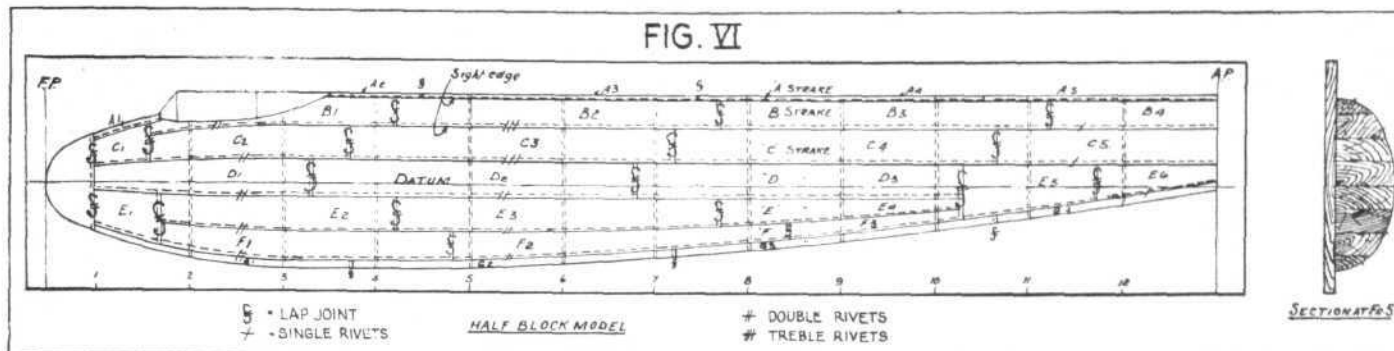
Another method is to glue all the slabs of wood together first, and then when set mark off the position of the stations, and having made templates as in Fig. III, cut grooves in the block until the template nearly beds down on the block at its respective position. Pare away all surplus wood and carefully rub down with glass paper until templates fit nicely at each station. On completion of model give two or three coats of flat white paint and mount on a baseboard. This baseboard should project beyond the model on all sides by at least 1 in., and should have its bottom edge dead parallel to the datum line.

Work on Model

On arrival of the model in the D.O. the draughtsman will now proceed to mark off the datum line at each end of the model. The bottom edge of the baseboard being a fixed distance below the datum, this enables him to locate the datum. Also along the bottom edge of the baseboard he will mark off all the station intervals, or, if possible, the position of the frames or formers for preference, as shown on the lines drawing. A special tool is now required like a planchette shown in Fig. V to carry out the necessary work on the model. The pencil fixed in the "planchette" is adjusted until it meets the surface of the model, and having brought same in line with a frame position proceed to mark the frame on the model from top to bottom, holding the "planchette" hard against the guide, Fig. IV and sliding same along, the model, of course, being placed with the baseboard flat on the bench. Having marked in all the frames, girth round a few frames on the lines Drg. that coincide with a "station" by taking a strip of paper and, from the bottom carry the strip round until you reach the intersection of the datum.

Having marked the bottom and the datum on this strip for, say, half-a-dozen frames at intervals in the length of the fuselage, transfer these points to the model, then pin a light pinewood batten through these points and mark in the datum on the model. This, of course, should be a straight line. We are now ready





to mark off the plates on the model, which is the sole purpose of making same. Although the gauge of the plates will vary from front to rear, the length from the manufacturers is generally the same.

The usual method of plating a fuselage is to "break joint," i.e., never to have two joints opposite one another, but to have at least two strokes between each joint measuring round the girth.

Cases do occur where the butts are arranged all to finish on a convenient frame to enable certain lengths of plate to be utilised. When this is done the strength of fuselage is made up by a considerable number of longitudinal stringers, hence an increase in weight. As this article is not dealing with the pros and cons of design, but the practical side of the work, we will proceed to the next step in the work.

Knowing the size and gauge of plates to be used, starting at the middle and working towards the ends, mark in the plates using as long a length as possible.

With a strip of paper having the width of the plate marked thereon, place one mark on the top centre line of the model and bend the strip round at each frame, marking the width of the plate on the model. We now have the first line of plating marked which will be the top plate on the finished fuselage. Of course, the joint may not commence on the centre line, but equally on each side when, of course, the strip of paper will only have half the plate width marked on it.

Next, one must decide the width of lap required to join the plates longitudinally, and mark same on our strip before proceeding to mark off the second line of plating. These lines of plating are called "strakes." The first one is "A" strake, and when marking off B, C, D strakes make sure your mark for the lap is inside the strake above.

All longitudinal seams must overlap with the sight edge downwards (see section, Fig. VI). After having marked off all the width of plates on the frames from top to bottom, procure a pinewood batten and pin same on model through each successive strake and pencil in

On a second strip of paper mark off the length of the plate to be used on "A" strake, and using as long a length as possible start at the middle with an equal length of plate each side of the middle frame and work fore and aft until you have all the lengths marked on

this stroke. When carrying out this operation do not omit to allow for the width of the lap joint at each plate after the first one. The plate in front of each adjacent one should lap over, that is, all laps should point aft.

Of course, one may be making all joints and seams butt jointed with a narrow plate behind to make the joint, when the allowance for overlap will be omitted. On marking off the lengths of plates on "B" strake start about one-third of the length from the plate above and carry on fore and aft. Start "C" strake in the opposite direction, and work as before. This insures that no two laps are opposite one another for at least two strakes. One must arrange this "shift of laps" throughout the whole fuselage and towards the ends it will not be possible to use the total length of plate in, and achieve this end, see Fig. VI at E1 and E5.

At the fore and aft end the plates become congested if one tries to keep the width constant. To avoid this cut the plate back in length at a convenient position to enable one standard width plate to occupy two strakes.

By now it will be obvious that the fuselage has been plated with a minimum of waste, and the haphazard method of trying a plate on the job in the shop and the risk of scrapping has been overcome. Assuming that all the "shell" plates have been marked on the model, collect all information *re* openings, such as side windows, doors, hatches, etc., and mark them on the side of the model. A complete half-block model should have all attachments to the "shell" dotted thereon, but the extent of detail will remain at the discretion of the draughtsman and the shop requirements. The primary object of the model is to obtain the exact size of the plating.

When everything has been marked on the model that is required, ink in, after final correction, and check, then give the whole surface a coat of clear varnish to preserve the marks thereon.

Shell Expansion

The next step is to prepare the "Shell Expansion" drawing for the half-block model, Fig. VII. This drawing is best described by imagining the model to be made of tin and flattened out from the round to a flat

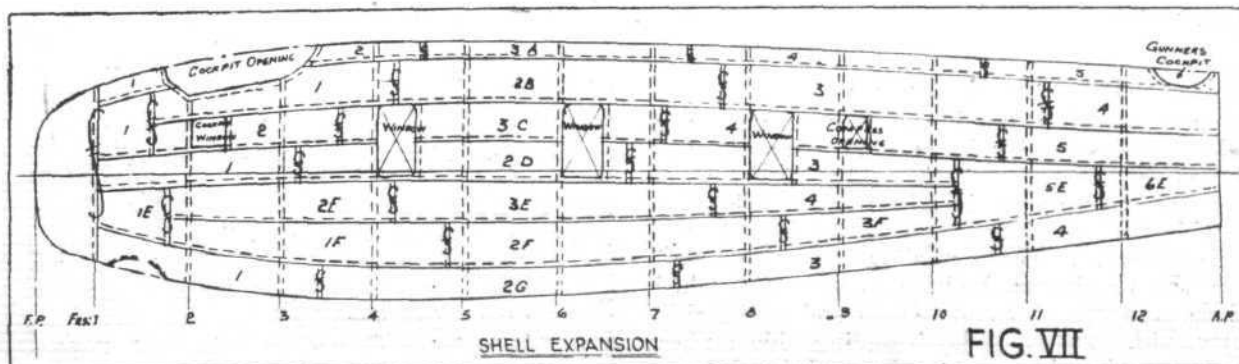


Fig. VII—Note, all openings, external fittings, doublings and shell drilling should be shown on this drawing

surface. The "girth" becomes flat, but the length remains the same, and is purely a guide to the plating squad in the shop to locate their plates.

Proceed to mark off on the paper for this drawing the datum and all the frames or formers to the same scale as the model, then with a strip of paper girth round the frames on the model and mark off all plate edges above and below the datum. Transfer these marks to the "Shell Expansion Drg." and when all the plates are drawn in we have a view showing the position of all plates on one side of the fuselage. Note that any opening, bracket, etc., only occurring on one side of the fuselage can still be indicated on the "Half-Block" model and "Shell Expansion" by labelling same "Stb. only" or "Port only" as the case may be.

Having transferred all the plates from the half-block model to the shell expansion and drawn in same, proceed to label all the strakes as A1, A2, B1, B2, etc., and when finished this drawing should be a complete copy of the "model" and is used by the foreman in charge of the plating as a guide for his work.

Plate Ordering

Last, but not least, the Plate Order List is prepared from the "model." (See Fig. II.)

Most of the plates amidships can be scaled off direct, as there is little double curvature, and entered on the order sheet with a $\frac{1}{4}$ in. extra in length and $\frac{1}{2}$ in. extra in width. Where a plate has double curvature, as at the nose, place a piece of tracing paper over same and mark the outline of the plate on the paper. When this paper is laid out flat we have the true shape of the flat plate for ordering. This process is called "lifting off." When these plates come in from the makers or are cut from stock, they are labelled as per list, and when all work is complete thereon they are placed in store, and as they are marked according to the Shell Expansion Drg., the foreman in charge of the fuselage plating knows exactly where each plate goes. It is not suggested here that separate departments should handle the plates, but one squad does all the rolling and shaping, drilling edges for rivets, etc.

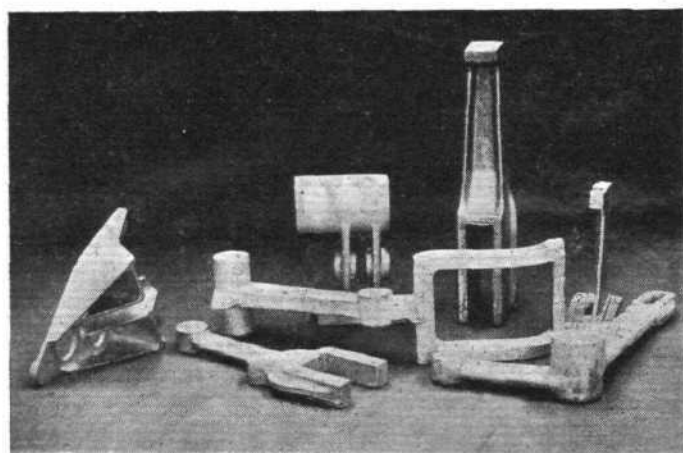
With a reasonable amount of good progress work beforehand, there should be no waiting one department for the other, and when the plates are required for the final riveting up on fuselage, they should be ready in store.

Here, perhaps, we should have mentioned that the "Order List" is prepared first from the model, and delivered to the ordering department, who, presumably, order same without delay, while the rest of the work is proceeding. Incidentally, the material for the frames, etc., is also "lifted off" the model, and a list made out similar to the plate order list. I have purposely refrained from mentioning the frames previously as they may be built-up plates with angles, or "Z" bars, etc., and require a separate drawing for each frame or batch of frames, but it is obvious that any information re the contour of the frames can be obtained from model.

In conclusion, the above procedure for lines, plating, etc., is applicable to either a "Monocoque Fuselage" or a flying-boat hull.

HIDUMINIUM R.R.53 B

Under the name "Hiduminium R.R.53 B," High Duty Alloys, Ltd., of Slough, have introduced a new light aluminium alloy. This is the result of many months of research work in the laboratories of the firm, with the object of altering the standard alloys to suit a particular purpose. The new alloy is a slight modification of the well-known Hiduminium R.R.53, which is one of the series of alloys introduced and patented by Rolls-Royce, Ltd. The new alloy is finding wide application for fast-moving levers, treadles and brackets in the textile and electrical industries, and should also



Some parts cast in Hiduminium R.R.53 B.

be suitable for the smaller forms of castings in the aircraft industry.

The analysis of Hiduminium R.R. 53 B is as follows:

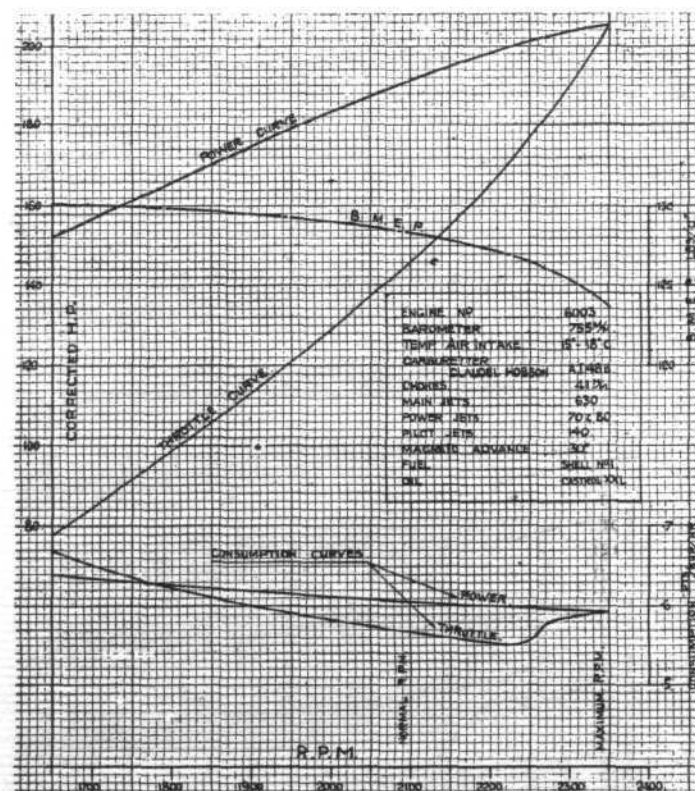
Copper	...	2.5	per cent.
Nickel	...	1.5	" "
Magnesium	...	0.8	" "
Iron	...	1.2	" "
Silicon	...	1.2	" "

The physical properties in the various conditions are as follows:—

	Chill Cast		Elongation per cent.	Brinell Hardness.
	P.S. Tons/sq. in.	Stress Tons/sq. in.		
	Tons	Tons		
As cast	8	14	3	75
Solution treated	12	22	6	103
Solution treated and artificially aged	23	26	3	129

	Sand Cast Test Bars		Elongation Per cent.	Brinell Hardness
	P.S. Tons/sq. in.	Stress Tons/sq. in.		
	Tons	Tons		
As cast	8	12	1½	80
Solution treated	12	17	3½	110
Solution treated and artificially aged	19	21	1	129

The specific gravity is much the same as for "Hiduminium" R.R. 53 alloy.



Power and throttle curves of De Havilland "Gipsy Six" engine. (See pages 84-86.)

"ETHYL"

Some information on the use and advantages gained by the employment of
TETRAETHYL LEAD
in fuels for aviation engines

By F. R. BANKS, O.B.E., F.R.Ae.S., M.INST.P.T.

(Extracted from a paper read before the Royal Aeronautical Society on January 18, 1934)

The importance of Mr. Banks' paper cannot be over-estimated as it is probably the first time that the "leaded fuel" position has been placed so clearly before the public. Something of this kind has been wanted for a long time. There has been a great deal of misconception over the whole matter and now that fuels of high knock value are being permitted by the Air Ministry—a D.T.D. specification No. 230 now calls for an 87 Octane standard—this clear exposition as to the advantages and drawbacks of tetraethyl lead is most opportune. In the following pages we offer our readers a very abridged edition of the first part of the paper. It deals with lead, in the form of Ethyl fluid, and tells us what this commodity is. In the AIRCRAFT ENGINEER will be found a further précis of the paper dealing with the more technical aspects of the actual use of Ethyl. Those readers who feel they would like to have an even deeper knowledge of the subject should obtain the Royal Aeronautical Society's Journal, at a later date, when this is published with the full report of Mr. Banks' paper.

THIS paper is an endeavour to present as complete information as possible on the subject of a much discussed anti-knock material and to dispel any misconceptions regarding the use and behaviour of Ethyl. Much has been written during the last ten years on the importance of the fuel question, but it is only in the last two years or so that the aviation-engine manufacturers of this country have seriously considered fuel quality with that of engine rating. Neither the fuel suppliers nor the engine manufacturers can be said to have lagged behind in their respective spheres, but the real cause of the delay in the appreciation of the fuel question seemed to be a lack of understanding of each other's problems, or, at least, the inability of one side to obtain the confidence of the other. However, this state of affairs does not exist to-day, and the co-operation between the fuel suppliers and the engine manufacturers is in most cases very satisfactory.

Fuel Detonation and Overheating: Their Effects

It is assumed that the term "detonation" and the "physical" and "chemical" theories regarding it, are understood. It is not proposed to take up time in discussing these phenomena, as there are many works which deal with them at length. The fact that any of the fuels available in reasonable and practicable quantities to-day can be made to detonate or pre-ignite, under certain conditions, is our chief concern. The principal limitation of modern engine development is fuel detonation, or the effect of temperature rise on the engine parts, due to the behaviour of the fuel. In the case of large engines of high specific power output, audible detonation is not easy to detect, and often is not at all apparent. In fact, in a number of cases the term "detonation" is not, perhaps, quite correct. The particular phenomenon experienced with some fuels manifests itself in the form of a dangerous rise in the working temperature of the cylinder. This is particularly noticeable with air-cooled engines, and in many cases, either air- or water-cooled types, the engine will shut down due to pre-ignition, or definite damage accrue due to overheating without signs audible detonation. Cases have been met where engines have suffered from troubles in the form of scored or "scuffed" pistons, together with rings sticking and failure. Part of the piston crown and top ring land sometimes having crumbled and burned away. In some cases this trouble has been attributed to lubrication failure and the oil has been wrongly blamed. Naturally, engines should be designed so as to minimise the chances of

detonation, but engine design is all a compromise, and it is often very difficult to arrange even such essentials as the positions of the sparking plugs so that they can ignite the charge in the most efficient manner. The combustion chamber design itself must generally be subordinated to other requirements, such as low frontal area which, practically, demands a low stroke/bore ratio, making the flame travel distance (in the combustion chamber) large for a given clearance volume and the tendency to detonation greater. All these points make it harder to obtain high specific power output without running into detonation or overheating.

The influence of the "anti-knock" value or Octane number of the fuel on engine performance is well illustrated by the following authentic example:—

A well-known supercharged engine in this country, which is rated at approximately 500 b.h.p. at an altitude of 11,000 or 12,000 ft., was capable of developing nearly 900 b.h.p. at ground level when the fuel was changed from one conforming to the late D.T.D. 134 specification (75.5-76 Octane) to one of about 90 Octane under similar test conditions. For military aircraft, in times of national emergency, such as war, long periods of running between overhauls are not essential, and reliable operation for relatively few hours, probably 50 engine hours, is all that is required. Consequently, with a suitable fuel, modern engines could be run well above their present ratings and enable fighters to clip valuable seconds, and even minutes, from the normal time taken to reach their operating altitudes. Also, being able to use the full amount of supercharge possible, between ground level and operating altitude, would make such aircraft very formidable to an enemy whose machines may endeavour to create a surprise attack by coming in low down.

Fig. 1 shows two curves plotted from the results obtained from the actual tests of a fast single-seater interceptor fighter with two fuels. (A) with D.T.D. 134 fuel, (B) with D.T.D. 134 plus 4 c.c.'s of tetraethyl lead per gallon. No alteration was made otherwise. Fuel (B) allowed full throttle to be used from ground level to operating altitude. The increase in rate of climb from ground level to 10,500 ft., with this fuel, in comparison to fuel (A) is about 38 per cent. and from ground level to 20,000 ft. is 16 per cent.

Fig. 2 gives some idea of the relationship between Octane number and B.M.E.P.

To obtain increased power from an engine of given cubical capacity there are three courses open to the designer, each or all of which may be taken. These are:—

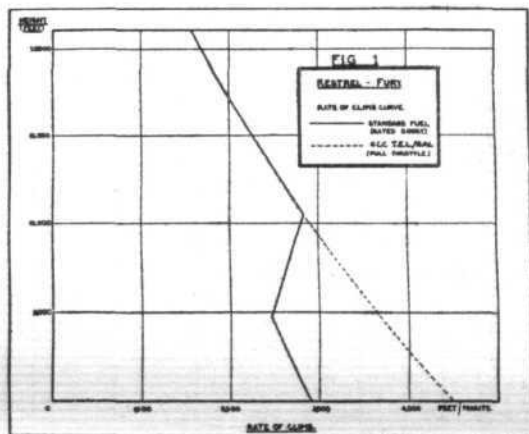


Fig. 1.—Shows the effect of adding lead to the fuel used in the engine of a single-seater fighter. The climb has been increased enormously.

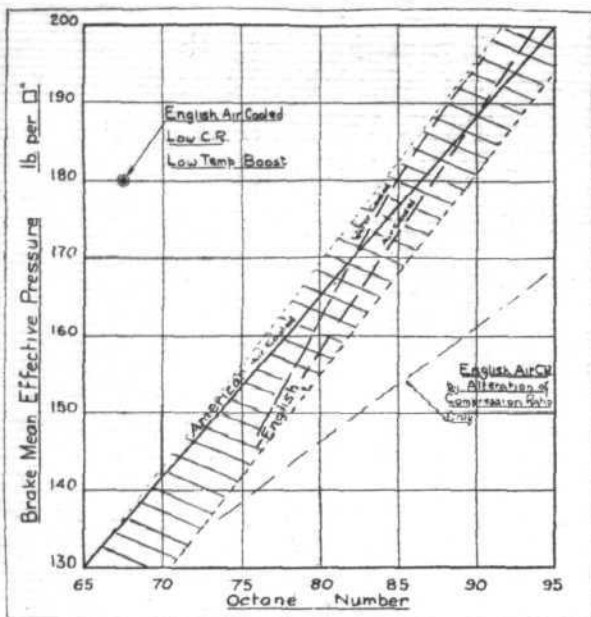


Fig. 2.—Relation between B.M.E.P. and Octane number in American and English engines.

- (a) Raising the compression ratio ;
- (b) Supercharging ;
- (c) Increasing the crankshaft speed (r.p.m.).

An increase in the compression ratio will improve the power output, lower the specific fuel consumption, and reduce the amount of heat to cooling medium, lowering also the temperature of the gases at exhaust point. A supercharger or blower, whether used for filling cylinders to maintain "ground level" power at altitude or for definitely "boosting" an engine to give a higher specific power, is being used more generally.

The limitations to high crankshaft speeds are the loadings on the reciprocating parts and bearings, but these, although big difficulties to overcome, are not insuperable, and there is a general tendency to increase operational speeds of modern engines. These methods of increasing the specific power output impose a heavy duty upon the fuel, and may cause detonation and overheating, with their attendant troubles, such as pre-ignition, damaged pistons and big ends and overheated exhaust valves.

Fig. 3 gives a curve showing the effect of compression ratio on power and fuel consumption at constant speed. In this connection, one would add that where a supercharger is fitted, and if it is desired to increase the power output further by using a greater degree of supercharge in addition to raising the compression ratio, it would be well to make careful bench tests in order to obtain the most suitable values for each when working in combination.

The Choice of Anti-Knock Materials for Aviation Fuels

There are at the moment two practical anti-knock materials available to the fuel suppliers of this country in order to make up suitable fuels. These are:—

- (1) Benzol ;
- (2) Ethyl fluid (tetraethyl lead).

(1) *Benzol*.—Benzol has been used for some years, with success, as an anti-knock material. It is a fuel in itself of exceedingly high anti-knock value and does not usually detonate in the ordinary sense, but can give rise to severe pre-ignition under appropriate conditions. Benzol is not generally used by itself but is blended with petrols. The amount added to any petrol naturally depends upon the anti-knock value of the basic petrol used and the final value required. Quite usual quantities of benzol in such blends may vary between, say, 10 per cent. to 30 per cent. by

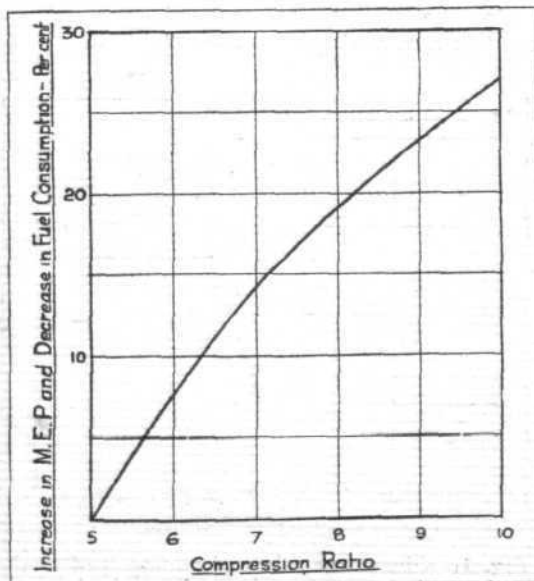


Fig. 3.—Effect of Compression Ratio on M.E.P. and fuel consumption.

volume, or more. From the economic aspect, and having in view the development of civil and military aviation in the near future, it appears that adequate supplies of benzol will be difficult to obtain to meet all needs. In fact, this situation already exists, and in a number of European countries it is hardly possible, if not impossible, to obtain. In addition to the relatively large quantity which must be added to a petrol, to be effective, benzol is expensive even in those countries where its production is satisfactory. In the case of war, all the supplies of benzol would undoubtedly be commandeered for the manufacture of explosives. For peace-time military purposes, while cost is important, it is not necessarily the ruling factor where engines must have the correct fuel, but even allowing for this, the performance of the modern military aeroplane has been largely responsible for relegating benzol to a secondary position as an anti-knock material in aviation fuels, due to the former's capability of operating at considerable altitudes. The principal constituent of benzol is benzene. Benzene has a freezing point of about +5 deg. C. Consequently, to avoid freezing troubles in the fuel system, the amount of benzol which can be added to any petrol must be very much restricted if aircraft are to operate with safety at altitudes which may vary from 15,000 to 30,000 ft., or, in cold climates. The satisfactory operation of engines in cold climates is also important for civil work. Again, one of the principal conditions of a civil aviation concern is to be able to obtain adequate supplies of uniform material universally, or at least at points along the particular routes operated by it.

(2) *Ethyl fluid (tetraethyl lead)*.—Ethyl fluid is not a fuel, but may be called a chemical knock suppressor. Its basis is well known and is an organo metallic compound known as tetraethyl lead. It is completely soluble in petrol and will not separate out under any normal storage conditions. All Ethyl fluid is coloured and that for aviation use is blue. A definite standard of colour is maintained for all blends of fuel containing Ethyl fluid. The fluid is supplied in drums to the oil companies concerned and, provided that these are kept airtight, it may be stored almost indefinitely. Its distribution to blending points in any country is, therefore, simple. Due to its potency, the amount added to any petrol is almost minute. Naturally, the concentration will vary according to the basic anti-knock value of the particular petrol, and the final value required, which is also controlled by the degree of susceptibility of the petrol itself to tetraethyl lead.

Some idea of the effectiveness of tetraethyl lead may be had when it is stated that the addition of the first cubic centimetre (1.0 c.c.) per gallon (4,545 c.c.'s) to a petrol can raise the anti-knock value of that petrol by anything from 5 to 15 Octane numbers, again, of course, depending on the characteristics of the petrol. A further important point is that the addition of Ethyl fluid to any petrol does not affect the latter's characteristics. The specific gravity, distillation range, and, what is more important, freezing point, remain sensibly constant. In fact, the fluid has no effect until it reaches the combustion chamber of the engine, and the petrol may be regarded as a convenient "carrier" by which it is introduced to and distributed in the cylinders. Its ease of handling, through standardised blending plants, the convenience of transporting it and its effectiveness as an anti-knock agent, make Ethyl fluid almost ideal for the purposes of military and civil aviation. Personally, one will go so far as to say that it is the only material in use at the present time which can insure the supply of fuels of uniformly high anti-knock value (Octane number) nationally and internationally.

Tetraethyl lead, the anti-knock constituent in the fluid, could not be used satisfactorily by itself because the lead oxide, formed during the combustion process in the engine cylinders, would deposit at fairly high rate. Ethylene dibromide is included in the fluid as the result of extensive

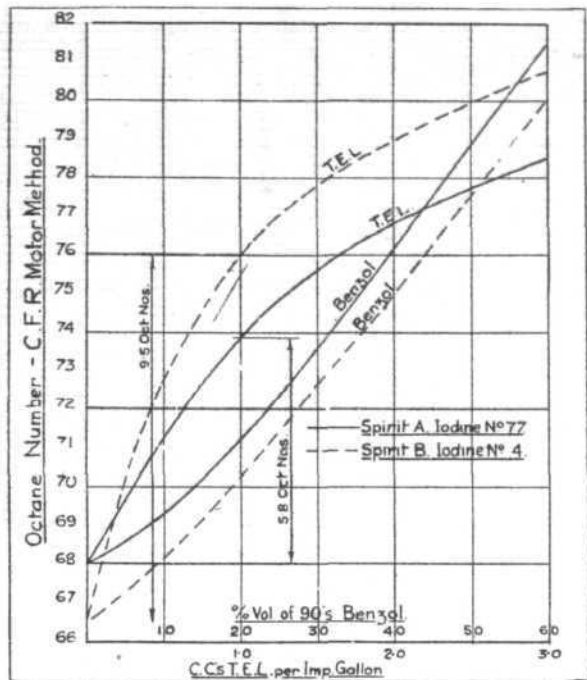


Fig. 4.—Curve showing the response of T.E.L. and Benzol in fuels of differing characteristics.

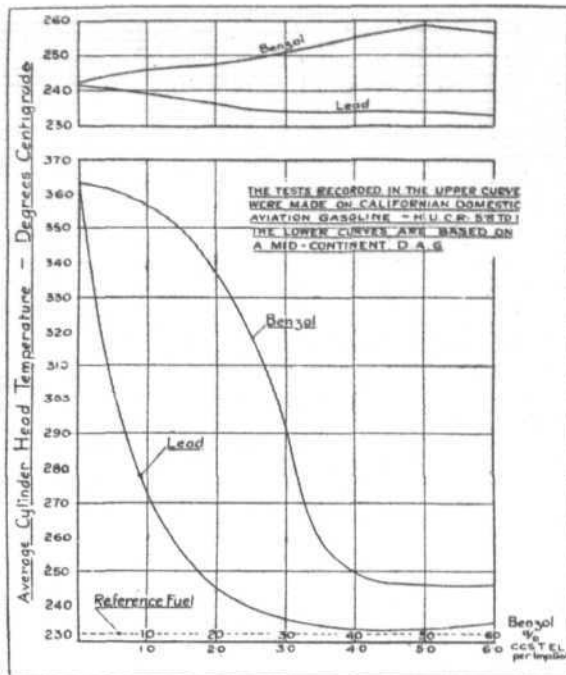


Fig. 5.—Reduction of cylinder-head temperature from the use of anti-detonants.

investigation. This converts the lead oxide to lead bromide which is volatile at the working temperatures prevailing in the cylinder and is evacuated with the exhaust gases in the normal manner. The amount of tetraethyl lead and not fluid is referred to when speaking of concentrations in petrol, since the lead is the active anti-knock agent. The amounts used are so exceedingly small that confusion is avoided and greater accuracy is ensured when this procedure is adopted. Subsequent references in this paper will apply to the concentration of tetraethyl lead only, and for the sake of brevity this will generally be designated as "lead."

The maximum allowable concentration of lead in any fuel, for commercial purposes, is 3.6 c.c. per Imperial gallon. For governmental and/or military purposes the concentration may be increased to 7.0 c.c. per Imperial gallon. Tetraethyl lead is poisonous and it can be absorbed into the human system through the skin or by the mouth or by inhalation, but the precautions taken in its manufacture and blending with petrol in special plants, obviate any risks to the operating personnel. In its diluted state in petrol there is no danger whatever, and fuels containing lead can be handled in the same manner as ordinary petrols.

The Effect of Tetraethyl Lead

There are many who think that the lead, in stopping or preventing detonation, "slows up" the combustion process considerably, but from the results of many tests this does not appear to be the case. This is not to say that "slowing up" does not occur, but it does not appear to be of great magnitude, say, in comparison with benzol. With high-benzol mixtures the temperature of the cylinder head tends to rise, and this feature has been particularly noticeable with air-cooled engines under certain conditions. The exhaust temperature is generally higher under these conditions and often rises if the amount of benzol in the particular blend is further increased.

The use of fuels containing lead does not in general raise the cylinder head or exhaust temperatures, rather the reverse in some cases, but for all practical purposes they remain substantially the same. This naturally assumes that there is no detonation present in either case. There is one peculiarity regarding the effect of lead upon the anti-knock value of a petrol; it is, that a progressive increase in the lead concentration does not give a corresponding increase in anti-knock or Octane value. Rather, the increase in Octane value gets progressively less with increasing lead concentrations. In the case of benzol, increasing amounts blended with a petrol usually show progressive improvement in the anti-knock value of the resultant fuel. Fig. 4 shows these features up quite clearly and also shows up the difference in susceptibility of two petrols of unlike

characteristics, to additions of anti-knock material. One petrol is highly cracked and the other has a naphthenic base.

There is, however, one very important point scored by a fuel containing lead over a benzol blend. Suppose two such fuels to have similar knock ratings when tested under the following conditions:—A Series 30 knock-testing unit running at 600 r.p.m. with a jacket temperature 100 deg. C. Now suppose the fuels to be re-tested on the same engine but with the speed and jacket temperature increased to 900 r.p.m. and 190 deg. C. respectively; it will be found that the knock rating of the fuel containing lead may drop by, say, 3 or 4 Octane numbers (assuming a direct comparison with a primary reference standard of Octane/Heptane), but the benzol blend will probably have dropped eight or ten numbers. In fact, benzol has been supposed by many to have an anti-knock value much greater than pure Octane itself, whereas its actual and effective value, when blended with petrols and tested under conditions similar to those employed for checking aviation fuels, is about the same or even less than that of Octane. That is to say, its blending value, *i.e.*, its value when amounts up to about 50 per cent. of benzol are blended with petrols, is lower than that determined arithmetically by taking its estimated anti-knock value into account and

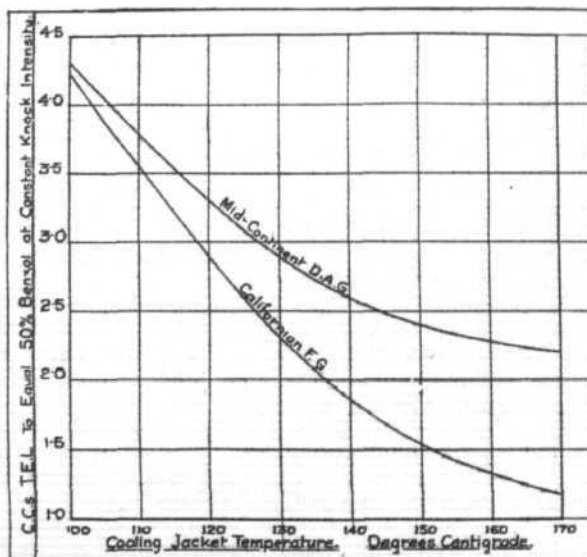


Fig. 6.—Variation of Benzol-T.E.L. ratio in aviation fuels due to change of engine temperature.

assessing the contributory value of the proportion added. This is very clearly shown by the data contained in the paper by Garner, Evans, Sprake and Broom at the World Petroleum Congress last year.

The blending Octane value of benzol, under varying conditions of test, has been assessed and is given in the following table:—

Blending Octane value of Benzol under various test conditions, calculated from 50% concentrations.

Series 30 engine @ 600 r.p.m.		C.F.R. Engine, modified Motor Method, (I.P.T. Aviation Method) using mixture temp. of 260°F.
212°F	300°F	
100	93	95

It is, therefore, rather difficult, if not impossible, to assess the real value of benzol blends or "lead" additions in a fuel unless the conditions under which they will have to perform in normal service are known and can be simulated when the fuel is under test for knock rating. It is sufficient for the present to say that a leaded fuel, in comparison with a benzol blend, retains its anti-knock value to a high degree when subjected to conditions of high temperature.

Fig. 5 shows, graphically, the results of some tests carried out by the Pratt & Whitney firm in America on

one of their multi-cylinder air-cooled engines. The upper set of curves shows, very clearly, the marked tendency of benzol additions to raise the cylinder head temperature, whereas the addition of lead has the opposite effect. The lower curves show the increase of cylinder head temperatures, due to detonation, caused by the use of an inferior fuel and the progressive reduction of temperature by adding benzol or lead to eliminate detonation.

The Response of Tetraethyl Lead in Various Fuels

The increase in Octane number obtained by the addition of lead to a petrol depends not only on the chemical characteristics of the petrol itself, but also upon the actual conditions of test.

To illustrate this feature, Fig. 6 gives the lead susceptibility curves of two petrols under conditions of varying temperature (jacket). One is a good Californian and one a Mid-Continent spirit, and both are tested in relation to a benzol blend of 50 per cent. in each fuel. No doubt many, after hearing the foregoing, will be under the impression that the use of benzol, or, say, added aromatics, in aviation fuels is to be deprecated. It would, perhaps, be more correct to say that one considers the use of lead, both from a practical and economic standpoint to be more suitable for this purpose. There is no doubt, however, that if fuels of exceedingly high Octane values are desired, or, where basic fuels of very low values only, are obtainable, the use of added aromatics in conjunction with that of lead, will be resorted to, in order to achieve the desired results.

(As was to be expected, a paper of this importance gave rise to a discussion of considerable interest; unfortunately lack of space precludes our dealing with this until next week.—Ed.)

Airisms from the Four Winds

Grouping the French aviation industry

As a result of negotiations between the Wibault and Breguet concerns, M. Wibault will work with the Breguet Company. This company will also take over many of the Wibault staff. The Breguet Company is considering the acquisition of the Hanriot factories and aerodrome at Bourges. M. Couiznet has accepted the office of Consulting Engineer to the Breguet Company, and all his machines ordered for series construction will now be produced at the Breguet works. A similar agreement has been concluded between the Potez and Marcel Bloch concerns, whereby a certain proportion of Bloch production aircraft will be built by Potez.

Irish-built aeroplane ready

THE high-wing monoplane designed by Mr. Charles V. Foley, of Sligo, has now been completed, and is being inspected and tested for its certificate of airworthiness within the next week. To demonstrate the capabilities of his machine, which incorporates a new stabilising device, Mr. Foley is proposing to undertake a 3,400-mile flight in March after exhibiting the aircraft in Dublin, Sligo, Galway, Limerick and Cork. I understand, writes our Dublin correspondent, that Mr. Foley has received a wager of 30,000 dollars from an American financier, Mr. Herbert Bernstein, to fly to New York from Ireland. He also states that he has received a big offer from a United States aircraft firm for part of the patent rights in his emergency control device.

Autogiros for the Army

WE wish to correct an error which crept into our report last week regarding "Autogiros" for the Army. It was stated that the machines ordered were C.19's, as the C.30 was still experimental. Actually, the C.30 is no longer "experimental," and it is this type which the Army has ordered.

An Imperial Airways loss

It is with the deepest regret that we learn of the death, in tragic circumstances, of Maj. Swithin Gane Hodges, Station Superintendent for Imperial Airways at Broken Hill, South Africa. Maj. Hodges was in the air between Pietersburg and Germiston when he died. He was on his way to Johannesburg, where he had to face the amputation of a leg due to an attack of embolism in one of his knees. He had been with Imperial Airways for a number of years. A native of South Africa by birth, he

was educated both in that country and in England, and passed into the R.F.C. from Sandhurst in 1915. During the war he saw service in Egypt, Macedonia, Russia, Bulgaria, Turkey, Palestine and France, being awarded the M.C., A.F.C., Croix de Guerre and the Greek Medal of Military Merit, besides which he was mentioned in despatches. In 1919 he was granted a permanent commission. His loss will be keenly felt by all air travellers in South Africa.

Man Mohan Singh's misfortune

MAN MOHAN SINGH started in his Miles "Hawk" ("Hermes IV") from Croydon in the early hours of January 20. The heavily loaded machine swerved somewhat on taking off, but the pilot managed to make a very good correction and got away quite safely. Le Bourget was reached and flown over, and the journey continued past Paris. After a while oil began to pour on to the windscreen, and the oil pressure dropped to nothing. The engine was still running well, and Man Mohan Singh hoped to continue until daylight, but after a while he was compelled to land near Carcomb (Vaucluse). Seeing a wood under him, he decided to try a "pancake" landing in the tree tops, and all would have been well had not a tree taller than the rest caught his wing and swung him around, causing him to crash rather heavily. He was unfortunate enough to fracture a leg, but after that had been attended to he returned to the scene of the crash and took some photographs. He intends to make another attempt, as he has every confidence both in the machine and in the engine.

Indian air circus mishap

DURING the four days' exhibition at Dum Dum aerodrome, Calcutta, of Capt. Barnard's Air Circus, Mr. Longmore crashed a "Drone" into a tank. He was removed to hospital suffering from a fractured arm and other injuries.

Light plane record

A REPORT from America states that Lee Miles, flying a 740-lb. single-seater aeroplane, covered the 100-km. course at an average speed of 209.11 m.p.h., and claims a world's record for light aeroplanes.

An Atlantic cargo flight?

It is reported that two pilots, William H. Alexander and William C. Brooks, accompanied by a mechanic and a wireless operator, will set out in about two months' time to fly the Atlantic with a cargo. They will start from



THE "FOX MOTH" IN CANADA: In the course of its various duties in Canada, the D.H. "Fox Moth" is equipped with a variety of nether garments—wheels, skis and floats. Here is a "Fox Moth" with floats alighting in Toronto Harbour.

New York and hope to fly to Moscow in a three-engined Sikorsky machine.

The Indian Earthquake

FROM India comes a report that certain fanatical evil-wishers to the British Empire have laid the blame of the recent earthquake on England. They draw attention to the fact that the axis of the severest shocks followed closely the line of the Everest flight, and the mountain gods have thus wreaked their vengeance. Apparently the mountain gods are very indiscriminate in their justice, else would not England herself have suffered?

Colonial Secretary's air tour

SIR PHILIP CUNLIFFE-LISTER, the Colonial Secretary, who is making an aerial tour of East Africa, has developed a septic throat. He is ill in bed at Government House, Nairobi, and to the great regret of those who were to receive a visit from him, has been compelled to cancel all his engagements. The doctors state that there is no danger.

Air mail exhibition at Cairo

A THOROUGHLY representative display of flown covers of the British Empire, loaned by Francis J. Field, is being exhibited for the benefit of visiting delegates at Cairo during the Postal Congress. The entire period of mail flying under Government authority by balloon, aeroplane and airship, is covered, and there is a specimen from nearly all the principal States of the Empire. The development and range of Imperial Airways routes receives special attention, while the majority of exhibits are accompanied by maps of the airway and dated flight itineraries.

Williamson Manufacturing Co. annual dinner

THE Williamson Manufacturing Co., Ltd., held their Annual Dinner and Dance on Friday, January 12, when over 100 were present. Mr. C. M. Williamson, C.B.E., F.R.P.S., reported a record year of business which was marked by two outstanding events. The first being the successful photography of Mount Everest with "Eagle" cameras, which did so much good, not only for the Williamson Manufacturing Co., Ltd., but for British aviation in general. The second was the demonstration tour of the Baltic States carried out by Mr. P. T. Griffith, A.F.R.Ae.S., during the summer, when demonstrations were given in some 10 or 12 countries and over 4,000 miles were covered in just over a fortnight. This enterprise is already bringing its due reward and he felt that it was by no means impossible that he might be able to report another record in a year's time. Mr. P. T. Griffith, A.F.R.Ae.S., in welcoming the guests, said that he was very pleased to see the representatives of the A.I.D. present and the fact that they were able to join in the company's play as well as its work, spoke very highly of the very excellent and efficient spirit in which the A.I.D. carried out their duties.

The Hawker Athletic Club

THE Hawker Athletic Club held their annual dinner on Friday last at the Assembly Rooms, Surbiton. Mr.

T. O. M. Sopwith presided and took the opportunity of pointing to the remarkable success which had attended Hawker designs and Hawker productions during the last few years. He stated that no less than eight different types of aircraft were in production for the Royal Air Force and that more types of Hawker military aircraft have been supplied abroad than any other. He also stated that the change of status of the firm from a private to a public company had meant a great deal of additional work and responsibility. He thanked Mr. F. S. Spriggs, general manager, and Mr. H. K. Jones for their work in this connection. Mr. F. Sigrist, in proposing the toast of "The Athletic Club," stated that a new sports ground at Ham had been acquired for the benefit of the members. Mr. Cairns, in ably proposing the toast of the directorate, created considerable enthusiasm by his reference to the universal hopes that Mr. Sopwith would succeed in bringing back the "America" Cup. Among those present were Mr. F. I. Bennett, Flt. Lt. P. W. S. Bulman, Messrs. Chandler, Mace, Sayer, Lucas, Sutton, Seller, Newman, Pollard, etc.

B.G.A. general meeting

THE Annual General Meeting of the British Gliding Assn., Ltd., will be held in the Library of the Royal Aeronautical Society, 7, Albemarle Street, W.1, on Friday, February 23 next, at 7 p.m.

A change of name

WE are informed of the merger of two old-established engineering firms—Horseley Bridge & Engineering Co., Ltd., and Thomas Piggott & Co., Ltd., as from January 1 last. The firm will operate under the new name—Horseley Bridge & Thomas Piggott, Ltd., with administration offices at Tipton, Staffs. There is no change whatever in the management or policy of the company, and it is hoped that the new name will preserve the identity of both companies, and be easily recognisable to the customers of each.

Postal advertising

THE Postmaster-General has appointed S. H. Benson, Ltd., to handle advertising for the Post Office for 1934-35. Included in postal advertising is the Air Mail Service, the Post Office Savings Bank and general postal facilities.

A B.A.I.C. appointment

THE British Aviation Insurance Co., Ltd., announces that Mr. Eric Outram has joined the staff of their Claims Department. Mr. Outram is the son of Lt. Col. H. W. S. Outram, the Director of Aeronautical Inspection.

National Benzole appointment

WE understand that Mr. J. W. Clarke has been appointed to the position of Publicity Manager, *vice* Mr. E. O. Hughes, who has resigned.

A Lodge success

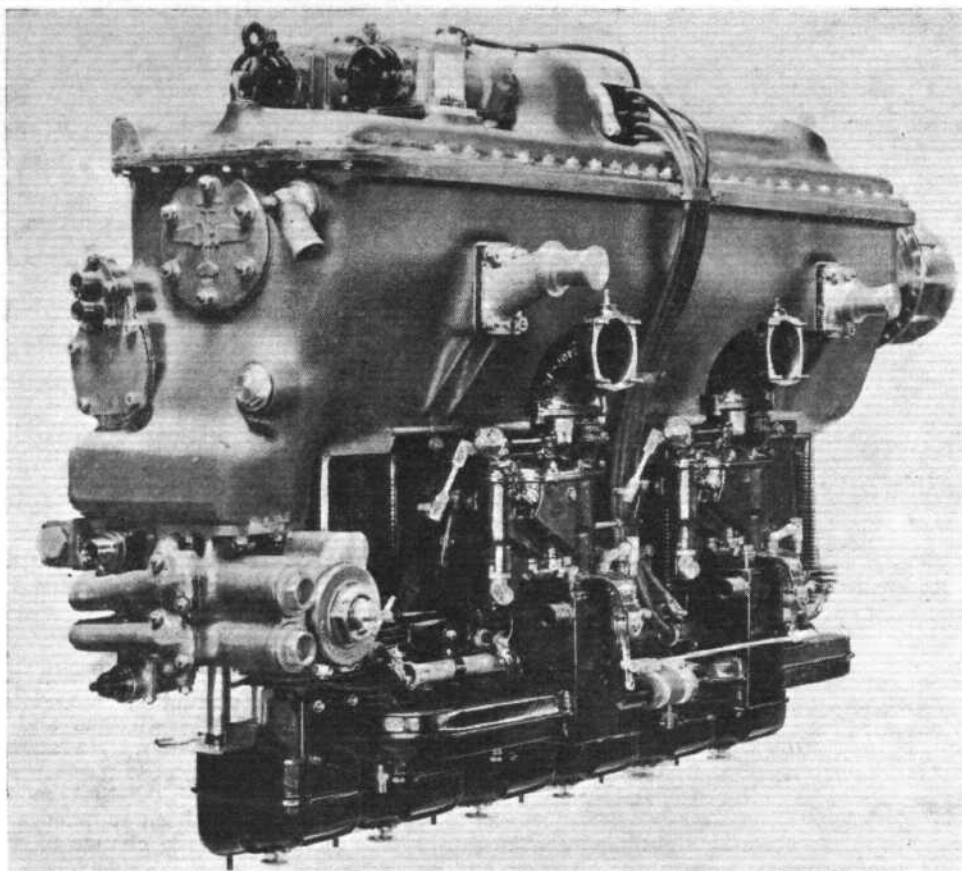
WE are informed that the Régnier engine in the "Caudron" monoplane with which M. Louis Massotte broke the international record for speed over 1,000 km. for aeroplanes of unlimited weight, at 358.185 km./hr., was fitted with Lodge plugs.

THE "GIPSY SIX"

The latest type of De Havilland engine has a number of parts in common with the "Gipsy Major," but has six cylinders instead of four and develops a normal power of 184 b.h.p. at 2,100 r.p.m. Like the "Gipsy Major" the "Gipsy Six" is a direct-drive engine.

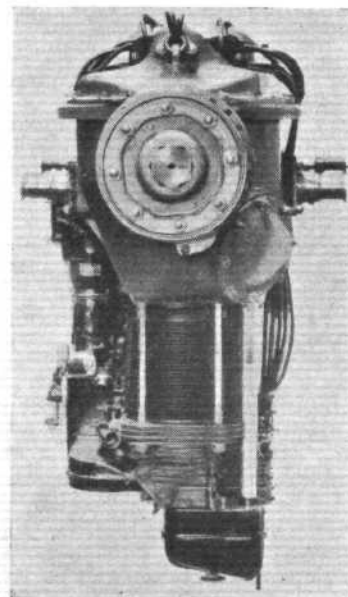
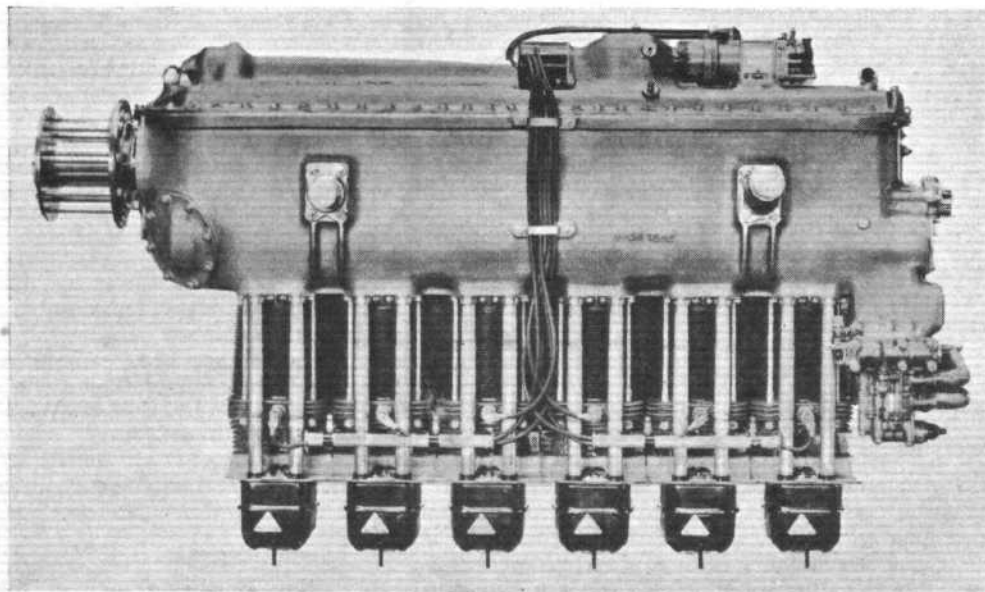
THE de Havilland Aircraft Co., Ltd., has established something of a record in the production of the "Gipsy Six" engine which was introduced to representatives of the Press on January 19. The firm has for many years followed the policy that one cannot consider too carefully the details and characteristics of a new type of aircraft or a new type of engine. But once the directors have taken the decision that a certain new type is to be produced, no time is lost in translating the plans into reality. One could not have a much better example of this policy than the "Gipsy Six" engine. The decision to produce the new six-cylinder engine was taken some time in July of last year. Major F. B. Halford, who designed the engine in close collaboration with Capt. G. de Havilland, at once got busy, and his drawing office sent the first drawing to the works on July 24. Mr. R. Hutchinson, who is works manager of the de Havilland Engine Department, was "all set" to start work, and things moved to such good purpose at Stag Lane that by 7.30 a.m. on September 29 the first engine was ready to be run.

Then followed a little over 3 weeks for development work, and on October 22 Mr. Hutchinson had four engines ready for installation in aeroplanes and one engine prepared for type tests. The Air Ministry type tests were completed on December 19.



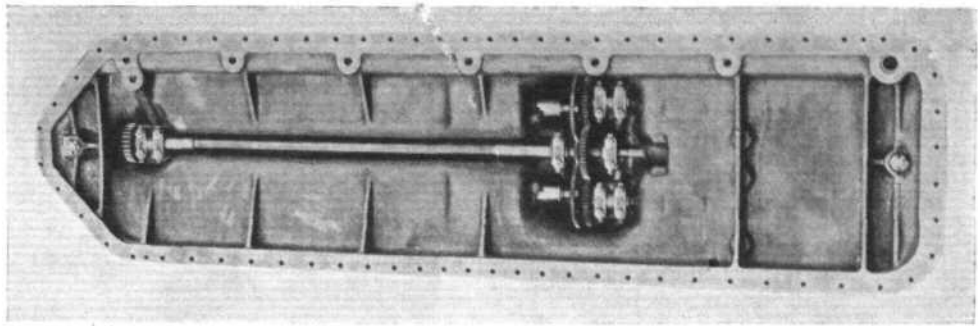
THE "GIPSY SIX": Induction side, showing two Claudel Hobson carburetors, Autoklean filter, and mounting brackets. Note the absence of accessories on the back of the engine.

It may be argued that as the "Gipsy Six" has a number of parts in common with the "Gipsy Major," the task of producing and perfecting the new engine was a relatively light one. But it must be remembered that many new important parts had to be designed and made. The crankcase is an electron casting, and had to be very rigid to ensure free running of the long six-throw crankshaft. In order to avoid too long an engine, the usual drives, etc., were removed from the back of the engine to positions where the drive is taken from the front end of the crankshaft. The effect of this has been to shorten the overall length to such an extent that the "Gipsy Six" is only the equivalent of about one cylinder longer



CLEANNESS: These side and front views show how remarkably neat the "Gipsy Six" is, with no external pipes, etc. The frontal area is very small.

THE CRANKCASE AND ITS COVER: The crankcase is carried on eight steel-backed white-metalled bearings. Like the crankcase, the top cover is of Electron, and carries the magnetos, distributors and their driving shaft. (FLIGHT Photos.)



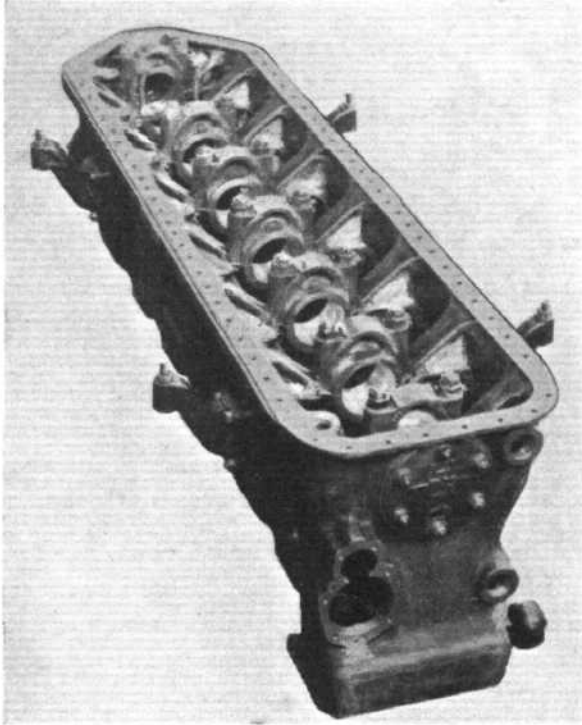
than the "Gipsy Major" instead of being two cylinders longer. The new drive for auxiliaries introduced fresh problems.

To guard against freezing, a novel and very ingenious scheme was evolved. The flame trap in the induction system is provided with a flap valve so arranged that at full throttle the valve cuts off communication with the flame trap and joins the carburettor to a duct facing into the airscrew slipstream. Thus at full throttle the engine is supplied with cold air and the loss of power from the flame trap and warm air is avoided. At cruising speed, or when throttled down, the engine draws warm air from inside the engine cowling through the flame trap, and all risk of freezing is avoided. The control is linked to and operated by the throttle.

It will be realised that there were many other problems to solve, and that it was not just a matter of making the crankcase a little longer and putting existing "Gipsy Major" parts on it, but sufficient has been said to indicate that to produce the new engine in so short a time was something of an achievement.

A detailed specification of the "Gipsy Six" will be found below, but the main features may be summarised as follows: The engine is a six-cylinder inverted air-cooled, with a bore of 118 mm. (4.646 in.), a stroke of 140 mm. (5.512 in.), and a capacity of 9,186 cc. (560.6 cu. in.). The normal power is 184 b.h.p. at 2,100 r.p.m., and the maximum power 205 b.h.p. at 2,350 r.p.m. The compression ratio is 5.25:1, and the weight of the engine, complete with airscrew boss, fuel pumps, and cylinder cowling, but without starter or generator, is 432 lb.

The fuel consumption at full throttle at 2,350 r.p.m. is 15 gallons per hour, and the specific petrol consumption at cruising power is 0.55 pints per h.p. per hour. At



normal r.p.m. the oil consumption is 3-4 pints per hour.

Compared with a specific weight of 2.3 lb./h.p. max. of the "Gipsy Major," the "Gipsy Six" weighs but 2.11 lb./h.p. max. The frontal area is to all intents and purposes the same as that of the four-cylinder engine, while the balance is, of course, better and the torque more even, a fact which is obvious when one sees these engines running in the D.H.86, where four of them are mounted on the leading edge of the lower wing.

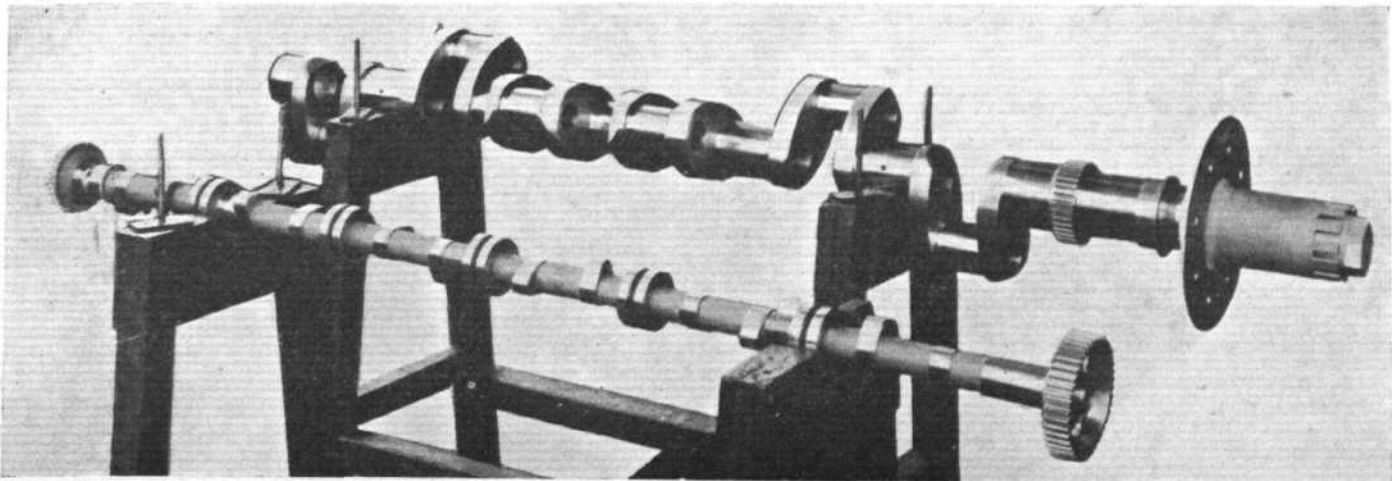
GENERAL DESCRIPTION

The Gipsy Six is a six-cylinder, inverted, in-line type of air-cooled engine.

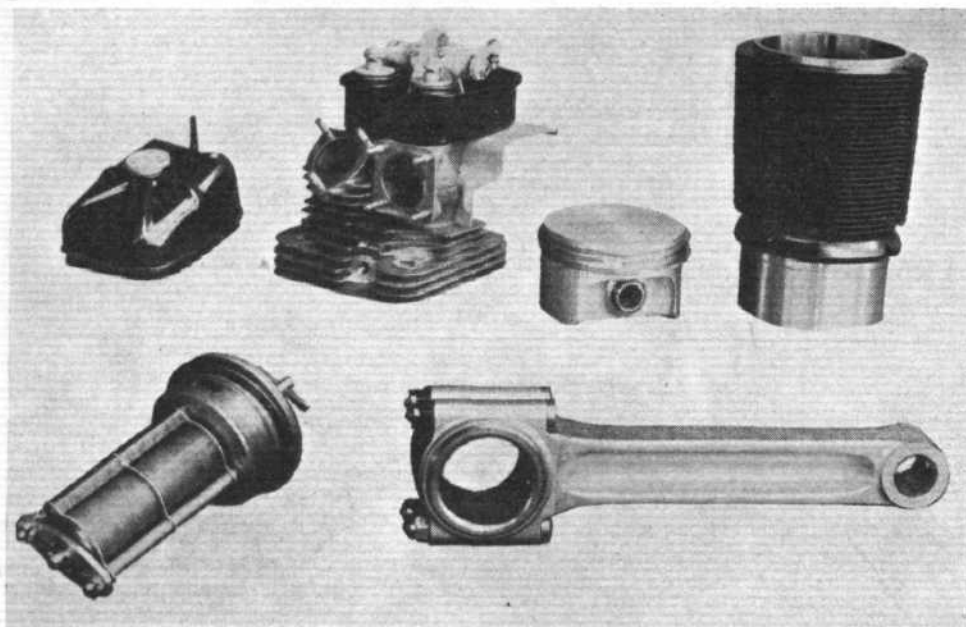
Cylinders.—The cylinder barrels are machined all over from carbon steel forgings. Special attention has been directed to the graduation of wall thickness and depth of finning in order that distortion may be avoided and an even cooling effect obtained. The ends of the barrels project deeply into the interior of the crankcase and so provide an ample capacity for oil drainage without danger of flooding the pistons. An oil-tight joint is assured by the use of a dermatine ring which is trapped in a recess between the cylinder flange and the crankcase face. The exposed surfaces of the cylinders are specially treated against corrosion.

Cylinder Heads.—Detachable heads cast in aluminium bronze are held to the cylinder barrels by long high-tensile steel studs extending from the crankcase. A gas-tight joint is maintained between the head and barrel by the interposition of a copper and asbestos washer located in a recess in the cylinder head. The two valves for each cylinder are arranged vertically and have seatings machined directly in the material of the cylinder head. Dual ignition is provided for each cylinder by two 12 mm. sparking plugs, which are located one on each side of a compact combustion chamber. The excellent form of the cylinder head permits of smooth but rapid combustion, and all standard Gipsy engines will operate successfully on good grade automobile fuel. The finning has been carefully arranged so that, with the adequate area provided, effective cooling is a straightforward matter on any aircraft.

Pistons.—Slipper type, cast in heat-treated aluminium alloy (Hiduminium) to D.T.D. specification 131. The piston is so designed that the thrust from the crown is taken direct to the gudgeon pin bosses and is not transmitted via the skirt. Fully floating gudgeon pins are located at each end by external



CRANKSHAFT AND CAMSHAFT: The latter is driven from the front end of the former. (FLIGHT Photo.)



SOME "GIPSY SIX" PARTS :
Top row, valve rocker cover, cylinder head in aluminium bronze, piston and cylinder. Bottom row, the Autoklean filter and a connecting rod. The latter is of Hiduminium alloy.
(Power Curves on page 78 h)

circlips and washers. Three piston rings are fitted below the gudgeon pin on each piston. The ring nearest the gudgeon pin is of the scraper type and contributes to the low oil consumption of this engine.

Connecting Rods.—Of robust design, the connecting rods are machined from forgings of D.T.D. 130 (Hiduminium) alloy. The big end is exceptionally rigid, being clamped by four high-tensile bolts. A bronze shell, lined with white metal, constitutes the big end bearing.

Crankshaft.—The crankshaft is machined all over from a nickel chromium alloy steel forging and is balanced statically and dynamically. It rotates in eight steel-backed, white-metalled, main bearings. A ball thrust bearing is provided near the front end to locate the shaft and transmit fore and aft loads arising from the airscrew. The ample support provided and the rigid construction employed ensure perfect alignment and make for smooth running and long life. The journals and pins are drilled for lightness and lubrication. All main bearings are fed continuously with oil under pressure.

Airscrew Boss.—The airscrew boss is fitted on a tapered extension of the crankshaft and is driven by two keys. The propeller itself is positioned by the central hub of the airscrew boss and is driven by eight through-bolts passing between the front and rear airscrew boss flanges. As the front flange plate is positively driven, the eight bolts are relieved of unnecessary stress while transmitting the drive from crankshaft to propeller. Positive means of locking the propeller nuts are provided within a quickly detachable spinner located on the front plate.

Crankcase and Top Cover.—The crankcase is cast in elektron and as the main bearings lie some distance below the joint-face, an exceptionally deep and rigid construction is obtained. Each intermediate bearing is supported by a stiff cross-member extending right across the crankcase. The main bearing shells are retained by separate caps, which, being readily accessible by removal of the top cover, facilitate assembly, inspection and overhaul. There is no separate timing case in the usual sense and the rear of the crankcase is formed with an enlargement to provide a small oil sump. Appropriate facings are provided on the crankcase for bearer feet, breather, petrol pumps, oil pumps and filters, tachometer drives and engine starter. The top cover is also cast in elektron and, besides forming a cover to close the top of the crankcase, serves as a mounting for the magnetos, distributors, and generator drive attachments.

Camshaft and Valve Operation.—The camshaft is supported by seven bearings on the port side of the engine and operates directly on hardened steel tappets. The motion is transmitted to the valves by tubular duralumin push rods and steel rockers. The bushed rockers oscillate on a hardened spindle, which is attached to the cylinder head by a stout steel bracket. A simple means of adjusting the valve clearance is provided by a movable screw with locknut accessibly mounted on the push rod end of the valve rocker. All striking parts of the valve gear are hardened and are readily replaceable. The whole of the gear is totally enclosed and is lubricated by splash from the rockers dipping in an oil bath provided in the valve casing covers. Owing to the exclusion of dust and to the excellent lubrication provided, wear of the moving parts is very small indeed after prolonged running. It might be mentioned that provision has been made for substituting hydraulical operation of the valves later. This, it is thought, will reduce the force with which the valves hit the seating to about one-fourth.

Timing Gears and Auxiliary Drives.—The camshaft and all auxiliaries are driven from a gear wheel mounted on the front end of the crankshaft between the ball thrust bearing and first crank-throw. This is the steadiest point in the airscrew-crankshaft system and provides the smoothest drive for the accessories. A drive, free from all undue load fluctuations, means long life and satisfactory service from the units involved. From the crankshaft gear the drive, in this instance, is taken via a train of hardened and profile-ground gears downwards to the camshaft and upwards to a long shaft mounted longitudinally inside the top cover. This fore-and-aft shaft runs at 1.5 crankshaft speed and at its rear end meshes with gears driving the two magnetos and their separate distributors. When required, a flexible drive may be attached to the rear end of the long shaft and taken outside the top cover for the purpose of driving a remote electrical generator. A bevel gear situated on the rear end of the camshaft drives a vertical shaft connected at its lower end to the oil pumps. The camshaft also provides drives for the dual petrol pumps and tachometer connections situated on the rear wall of the crankcase.

Lubrication.—The oil pumps and filters form a detachable unit bolted on to the bulbous extension at the rear end of the crankcase. A gear type

pump draws oil from a separate tank and delivers under pressure to an Autoklean filter which ensures the removal of the finest particles of foreign matter before passing the oil into the engine. A coarse gauze filter protects the suction side of the pressure pump while the main oil pressure is regulated to 40/45 lb. per sq. in. by an adjustable relief valve.

From the pressure filter, the oil divides into two streams. The main stream flows upwards to the top cover and along a cast-in gallery connected by drillings to the crankshaft main bearings. Thence the oil passes into the crankshaft and so through the hollow journals and crank pins to the big ends. Holes are drilled in the big end bearings and connecting rod caps, from which oil is thrown on to the cylinder walls and pistons. This arrangement is particularly useful at starting, as proper lubrication of the pistons is established during the first revolutions of the engine. Moreover, the supply of lubricant to the cylinder walls is maintained

irrespective of wear and clearance in the main bearings. The spray thus created inside the crankcase serves to lubricate the cams and tappets, and as a good deal of it ultimately comes into contact with the walls of the top cover, a useful cooling effect is obtained.

The second stream passes through a balanced piston mechanism which automatically reduces the pressure to approximately 15 lb. per sq. in. Oil at this reduced pressure is used to lubricate the camshafts, top magneto drive shaft and the various accessory drives. Thus, while every important bearing is pressure-lubricated, the flow of oil is not excessive and very little internal cooling suffices to maintain reasonable working temperatures for the lubricant. After passing through the engine, the oil collects in the space formed by the extension of the cylinders inside the crankcase and is drained away by two scavenger pumps. These pumps are arranged in tandem with the pressure pump and each is provided with a detachable suction filter of fine-mesh gauze. From these filters internal passages communicate with the front and rear of the crankcase, thus ensuring that the engine is definitely drained of all surplus oil whatever its attitude in flight. Apart from the connections to and from the separate oil tank, there is no internal or external pipe-work on the engine.

Ignition.—Ignition is provided by two B.T.H. six-cylinder magnetos mounted longitudinally on the crankcase top cover. In this position the magnetos are particularly accessible, add nothing to the length of the engine and conform very well to the general shape of the cowling. The magnetos are driven by profile-ground spur gears meshing one on either side of a corresponding central driving gear mounted on the long top shaft previously referred to. Each magneto has its own Simms' flexible vernier coupling and is provided with an improved type of impulse starter. This device ensures that the magneto delivers a strong spark at slow revolutions and so facilitates starting.

The high tension current from the magnetos is taken to two separate distributors arranged just forward of the magnetos themselves and driven at half engine speed from the longitudinal top shaft. Where radio is required, braided cables may be used and these are grouped and neatly led down the sides of the crankcase from the distributors to the appropriate sparking plugs.

Suitable mechanism is incorporated to ensure that the point of ignition is automatically retarded when starting and at slow speeds.

Induction System.—Mixture is supplied by two Claudel Hobson A.1 48B down-draught carburetters situated on the starboard side of the engine. Each carburetter supplies a short horizontal manifold feeding three cylinders. The air for combustion is drawn into the carburetter through a special air-intake system designed to avoid all freezing troubles without adverse effects as regards maximum power. Under normal cruising conditions (when freezing is most likely to occur) hot air is taken from the vicinity of the crankcase and led through a flame-trap direct to the carburetters. In this way a nicely-warmed induction is obtained, resulting in excellent smoothness and economy of operation. When, however, maximum output is required, the resistance of a flame-trap and a high induction temperature would somewhat reduce the horse-power obtainable. Under these circumstances, therefore, a throttle-operated valve closes communication between the flame trap and the carburetter and at the same time opens a duct communicating with the slipstream through a normal type of carburetter air intake.

Starting.—Provision is made on the rear wall of the crankcase for the attachment of a six-volt Rotax electrical starting unit. On closing a contact in the cockpit, this unit engages with a dog on the rear end of the crankshaft and an electric motor rotates the engine through gearing at sufficient speed to ensure satisfactory starting under all conditions. The dog coupling is automatically disengaged as soon as the engine fires. Arrangements are being made whereby an electrically-operated inertia starter may be substituted if, for reasons of installation, this type of unit is preferred.

Interchangeability.—It is important to note that a number of principal components are interchangeable as between the Gipsy Major and the Gipsy Six. These parts include cylinders, cylinder heads, valves and valve gear, pistons, piston rings, gudgeon pins, connecting rods, big ends, impulse starters and carburetters. In addition, there are a whole number of smaller parts which are interchangeable. This feature greatly simplifies the spares question and results in substantial economies where the two engines are operated in conjunction with one another.



Airport News

"THE LONDON AIR TERMINAL"

MR. NIGEL NORMAN, speaking before the London Society on Friday, January 19, evinced a partiality for the "Autogiro" type of flying machine for aerial transport to the centre of towns and cities, and gave his listeners the impression air transport development would necessitate faster cruising and faster landing speeds for inter-Continental and main line internal traffic, with somewhat slower machines for inter-city traffic, and finally something on the lines of the "Autogiro" for transport from the main aerodromes to the centre of cities.

His paper was entitled "The London Air Terminal," and was planned to emphasise the immediate need for airport planning for London, and to endeavour to estimate the extent of the air facilities to be planned for a period as envisaged by the Greater London Regional Plan.

Mr. Norman, who is a director of Airwork, Ltd., the proprietors of Heston Airport, and a partner in a firm of aeronautical consultants, is one of the few people who has given the matter of airport development the study and consideration it deserves. He started his paper with a statement of the position as it is to-day. He showed a map whereon was marked the aerodromes situated within twenty miles of the centre of London, also drawing attention to both Gatwick and Gravesend aerodromes, which, though actually lying outside the area in question, were nevertheless worthy of consideration as suitable to serve our capital city by virtue of their geographical position and their freedom from the climatic drawbacks of some of the other aerodromes. Gatwick in particular is important, as it has a main electrified railway station adjoining it, and the frequent service operated on that line makes the question of transport to London itself a comparatively easy one.

Mr. Norman gave figures to show the extent to which he expected air traffic to grow within the next eight years, pointing out that during the last eight years there had been a 62 per cent. increase in the amount of petrol used by taxi services and internal non-scheduled air lines, a 40 per cent. increase in the amount used by the flying clubs, and 20 per cent. increase in the amount used by private owners of aircraft, while the total consumption used for non-scheduled flying had risen by 32 per cent.

Referring to air travel in general, Mr. Norman visualised this as being divided into three categories: that between England and other countries, which he called Inter-Continental; that between major cities in England running on schedule lines, which he called City to City; and finally all other traffic between towns and on non-scheduled lines, designated Internal traffic. He considered that, generally speaking, it was likely that the time spent in travelling by each person would probably remain about the same during the period under review, but that the distance covered would increase greatly. Coming to the question of airports, he classed these as A, B, and C. "A" was the super-terminal catering for the inter-Continental traffic. It would have to deal with anything between 1,000 and 10,000 passengers a day, and assuming maximum loads of 50 persons, a traffic density at the worst period of some 200 landings per day. A clear runway of 2,000 yd. in each direction would be necessary, with one runway of at least 3,000 yd. for use in fog conditions for blind landings when there was no wind. An important point brought out was the necessity for controlling all traffic in the air anywhere near an airport of this nature, and Mr. Norman thought that a circle eight

miles in diameter should be drawn round a class "A" airport, in which all traffic was rigorously controlled. This would thereby allow, together with other ground developments at the airport, 100 per cent. fog landings. He thought that for the present, at any rate, one airport of this nature would cater for all the London traffic, with perhaps provision for another one.

With regard to the class "B" airport, he considered the present Air Ministry size sufficient, with a controlled zone around it four miles in diameter. This type would suffice for the City to City traffic, and also for manufacturers, repairers and similar purposes. Twelve of these airports would cover the needs of London at present, increasing to 24 to cater for the future.

Coming to the class "C," or In-town, airport, the present suggestions were, firstly Mr. Glover's wheel airport, which it is proposed should be built over King's Cross station. The magnitude of this somewhat frightened the lecturer, and the extent to which every feature would have to be tested before it was decided upon as a feasible and commercial scheme, relegated it to the somewhat distant future. The second proposition was the rotary one-way airport proposed by Mr. Frobisher. In this case the mechanical problems involved were considered to be terrific, but, despite that, the scheme appeared to have possibilities for an airport of the smaller type. The third idea was roofing over a section of the Thames or Waterloo station, both of which schemes seemed rather impractical and very expensive. Mr. Norman's own suggestion was a kind of two-level aerodrome, utilising the roof of a large building, one level for taking off and one for landing, and this was entirely dependent on the use of aircraft of the "Autogiro" type. With this type he thought even now it was possible to transport people to and from the centres of cities by air. Mr. Norman suggested that twenty In-town airports would suffice for London at the present time, with provision for development of a further twenty.

Turning then to the question of communication to airports, the lecturer said that undoubtedly road communication was the best. Contrary to general belief, the Underground railway was shown to be of very little use, because it had no provision whatsoever for the transport of freight, baggage or mail. A railway track, electrified or otherwise, provided it had a very frequent service running over it, was also excellent and in some ways perhaps even better than having to rely entirely on road transport. It would, however, be necessary to have something like a ten-minute service running if undue delays to passengers were to be avoided. From these considerations the conclusion was reached that for the class "A" airport the suburban main line railway communication was the best, provided a frequent service was given. For the class "B" aerodrome the Underground would probably suffice, but road communication would also have to be provided. For the class "C" or In-town airport the question hardly arose, as its very nature placed it alongside existing communication systems.

A number of slides were then shown of general interest, after which, in conclusion, the lecturer impressed upon his audience the urgency for action in the matter. He pointed out that the London Society has been instrumental in preserving green spaces in the city, and that they should now concern themselves with the retention of suitable areas for airports. He wound up by imploring them not to provide for the air travellers of to-morrow, facilities of yesterday.

CROYDON

AT the beginning of the week a meeting was called by the Air Ministry to discuss the future use of the Croydon radio beacon. Maj. Mealing was in the chair, and representatives of the various interested companies were present. Unusual but thoroughly welcome members of the meeting were Mr. Ivor McClure, of the A.A., and Mr. Denman, of Airwork, Heston. It was decided to bring the beacon into operation experiment-

ally, but rather as an aid to coming in to land than as an invisible highway along which to fly. It was thought that it would only be really needed for the last 20-30 miles when approaching Croydon. As its range, when reduced to a safe and reasonable height, will be lessened to somewhere in the region of 20-30 miles, this fits in very well with the decision either to lower it to a safe height or to remove it from its present position. Probably the former course will be adopted. There seems no reason why lowering it should create difficulties, as in Amsterdam the radio beacon is so low as to form no obstruction to air traffic at

a very busy port. Incidentally, the use of a beacon for the last 30 miles or so when approaching Croydon will greatly relieve the wireless situation and allow of concentration of D.F. work on machines outside the 30-mile zone. It was stated at the meeting that the work of the Control Tower would be greatly facilitated by some such scheme.

On Saturday morning Mr. Man Mohan Singh, chief pilot of the Maharaja of Patiala, left Croydon at 4.25 a.m. for his long-promised Capetown flight. He was unlucky enough to make a forced landing near Paris, and broke a leg in two places. His return journey on Sunday was comfortable and without incident—in an Imperial Airways machine from Paris to Croydon.

Commercial flying has had some rather unfortunate incidents lately, and passenger lists are not so good as they have been, though the weather has had a good deal to do with the falling-off of traffic. Pleasure travellers do not travel in unpleasant weather, we must remember. Amongst air travellers during the week whose faith in the finest method of travel has not wavered must be numbered Lady Helen and Lady Margaret Vane-Tempest-Stewart, daughters of the Marquess of Londonderry, who arrived at Croydon by "Imperial" on Saturday. They had travelled from the East with Lady Londonderry, but she stayed in Paris.

Two naval ratings who missed their train in London for Portsmouth after depositing their kits in it took car to Croydon, hired an air taxi from Air Taxis, Ltd., for the reasonable sum of £6 10s., flew to Portsmouth and met their train there.

Capt. Stack and Mr. Norman Blackburn were seen at Croydon during the week. They were about to fly to Leeds.

Saturday seems a "good" day for commercial flying. I noticed in passing that K.L.M. were fully booked up on that day, and that amongst numerous other distinguished passengers who passed through the Airport that day was Sir Miles Lampson, former British Minister to China, and recently appointed High Commissioner for Egypt. He is said to be returning to Cairo shortly by air.

Members of Parliament are actually alive to the danger of innumerable pylons all over the country, and are suggesting—as if it were a brilliant and novel idea—that they should be illuminated in fog or at night.

The Chief Commercial Manager of L.M.S. says: "It is not only what the public want now that we have to look out for, but what they are going to ask for next." This would almost seem to indicate that a L.M.S. air service will shortly be in operation. Anyway, air services are what the public will ask for next.

A. VIATOR.

HESTON

MR. A. N. T. RANKIN and his wife, Lady Jean Rankin, made their first solo flights directly in succession on Saturday, January 13, after exactly six hours' dual instruction each. This is an hour less than the calculated average on the Avro "Cadets" used for training at Heston. Mr. Rankin was instructed by Mr. Brian Davy, while Lady Jean was a pupil of Capt. Baker.

In the course of the year 1933, the Airwork Service De-

Stag Lane passes

AIR MINISTRY Notice to Airmen No. 4 of 1934 states that the licence issued in respect of Stag Lane aerodrome was cancelled on January 5. The position is that the de Havilland Aircraft Company gave up a very large proportion of this aerodrome on January 1. There still remains a sufficiency for their own routine flight tests, but as the aerodrome has been sold to builders and is not now licensed, loads of bricks or other obstructions may be placed anywhere upon it at any moment without notice, and it is therefore both impracticable and insufficient for use by anyone else. The de Havilland Company have now owned Stag Lane for the past 13 years, as they purchased it in 1921 from Messrs. Warren & Smiles, who ran the L. & P. School of Flying. Previous to that they had leased it from the same firm for about a year, who in turn had been at the aerodrome for another year before that, after transferring their school from Hendon. The passing of this aerodrome is only a prelude to the transference of the

partment carried out 70 overhauls for the renewal of Certificates of Airworthiness. Airwork Engine Service are not behindhand, for they are now working at the rate of 200 cylinder bores and the regrinding of over 100 crankshaft journals every week. Their machinery, as is well known, is almost unique in England, and permits of very high speed work to an unusual degree of accuracy. (See THE AIRCRAFT ENGINEER, October 26, 1933).

SCHIPHOL (AMSTERDAM) IN 1933

THE scenes of rejoicing at the Schiphol aerodrome, Amsterdam, on the occasion of the return of the record-breaking *Pelikaan* on the last day but one of 1933, formed a brilliant climax to a year of steady development for that airport. Despite the adverse influence of national and international economic depression, air traffic showed a considerable increase. The passenger figures, which in 1931 were 14,020 and in 1932 18,420, rose in 1933 to 30,640, an increase of 66 per cent. in the year. The through-passenger traffic (included in the above totals) also showed a sharp increase from 5,525 in 1932 to 8,743 in 1933.

Perhaps even more welcome was the revival in goods traffic, which had shown a considerable falling-off the previous year. Last year's figure of 1,337,000 kg. was 33 per cent. greater than the 1932 total, and 5 per cent. greater than that for 1931. Postal traffic continues to climb up slowly: in 1931, 121,400 kg.; in 1932, 128,600 kg.; and in 1933, 130,400 kg. Last year the East Indian mails accounted for one-fourth of this total, compared with one-fifth in 1932.

The number of services again showed an increase. During the summer months Schiphol was a terminus or link for 21 daily services. Last year for the first time the express services from London and Paris via Amsterdam to Scandinavia and back were run on Sundays during the winter months, making a daily all-the-year service. The East Indian service operated regularly and without incident during the year. The aeroplane which left Schiphol on May 4 made the first connection with the London service; it was also the first aeroplane to fly via Singapore. During the months May to August the service was further speeded up, the outward journey taking nine, and the return eight, days.

During 1933 Schiphol was visited by 345 sport and tourist flyers, as against 295 the previous year.

The most notable event of local interest during the year was the opening of the Amsterdam Aero Club's club-house by Prince Henry of the Netherlands on September 23, which was the occasion of a very successful aerial display.

Among technical developments, mention must be made of the "radio beacon" installed on September 28, which has already proved its worth in facilitating landing in foggy weather, notably on the return of the *Pelikaan* on December 30. Progress has also been made in the task of modernising the road approaches to the airport and the new road from Amsterdam, which will bring Schiphol nearly two miles nearer the city, will be ready this year.

whole de Havilland aircraft factory to Hatfield. This will not, of course, take place immediately, but will be carried out as and when opportunity occurs. At the present time the aircraft Servicing Department has already been housed in a large new building at Hatfield and work is in progress on buildings for the rest of the factory.

Bristol Airport

A DEPUTATION from the Redditch Urban District Council visited the Bristol Airport on January 18. The visit was in connection with a proposed municipal aerodrome at Redditch, and the deputation appeared to be favourably impressed with what they saw at Bristol. On January 16 Western Airways, Ltd., supplied a "Dragon" to the Bristol Water Company to enable a survey and photography party to fly over the company's reservoirs at Blagdon and Cheddar. Bristol is one of the cities suffering from a severe water shortage, owing to the absence of rain. No doubt the advent of the flying meeting season will soon ensure an adequate water supply.

THE ROYAL AIR FORCE

London Gazette, January 16, 1934

General Duties Branch

The follg. Pilot Officers are promoted to rank of Flying Officer:—N. H. J. Tindal (April 10, 1933); H. J. Kirkpatrick (August 27, 1933).

Flt.-Lt. F. Beaumont is placed on half-pay list, scale B, from December 20, 1933, to Jan. 8, inclusive; Flt.-Lt. R. W. Hill is placed on half-pay list, scale A, from Dec. 11, 1933, to Dec. 31, 1933, inclusive; Lt.-Com. R. H. S. Rodger, R.N., F.O., R.A.F., ceases to be attached to R.A.F. on return to Naval duty (Jan. 17). The follg. Flight Lieuts. are transferred to Reserve, Class A:—R. W. E. Bryant (Jan. 14); G. H. W. Selby-Lowndes (Jan. 15).

F/O. M. R. Kelly resigns his short service commn. (Jan. 3); F/O. E. F. J. L'Estrange resigns his permanent commn. (Jan. 4); Flt.-Lt. C. F. Stevenson relinquishes his short service commn. on account of ill-health (Jan. 14).

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified:—

General Duties Branch

Squadron Leaders: A. W. Fletcher, O.B.E., D.F.C., A.F.C., to No. 204 (F.B.) Sqn., Mount Batten, 1.1.34, to Command, vice S/Ldr. K. B. Lloyd, A.F.C. R. T. B. Houghton, A.F.C., to No. 60 (B) Sqn., Kohat, India, 1.12.33, to Command, vice Wing Com. A. D. Pryor. W. K. Mercer, to No. 1 Air Defence Group H.Q., 8.1.34, for Personnel Staff duties, vice Sqd. Ldr., F. L. B. Hebbert.

Flight Lieutenants: R. S. Blucke, to Experimental Section, Royal Aircraft Establt., S. Farnborough, 6.1.34. J. H. Hutchinson, to Station H.Q., Biggin Hill, 4.1.34. J. B. M. Wallis, to No. 600 (City of London) (B) Sqn. Hendon, 4.1.34. J. M. Cohn, to No. 27 (B) Sqn., Kohat, India, 5.12.33. V. P. Feather, to No. 204 (F.B.) Sqn., Mount Batten, 4.12.33. F. E. Watts, to No. 216 (B.T.) Sqn., Heliopolis, Egypt, 13.12.33. G. Atkinson, to No. 210 (F.B.) Sqn., Pembroke Dock, 4.12.33. R. J. Bennett, No. 204 (F.B.) Sqn., Mount Batten, 4.12.33. T. J. Desmond, to Air Armament School, Eastchurch, 7.1.34. C. Halliwell, to No. 33 (B) Sqn., Bicester, 9.1.34. J. C. E. A. Johnson, to Station H.Q., Worthy Down, 9.1.34. J. S. Nichol, to Elect. and Wireless School, Cranwell, 8.1.34. G. T. H. Pack, to Reception Depot, West Drayton, 8.1.34.

Flying Officers: G. E. S. Williams, to Station Flight, Andover, 10.1.34. G. F. Humphries, to No. 204 (F.B.) Sqn., Mount Batten, 4.12.33. C. C. McMullen, to No. 201 (F.B.) Sqn., Calshot, 4.12.33. M. B. Hamilton, to No. 801 (F.F.) Sqn., Netheravon, 9.1.34. C. M. Rees, to R.A.F. Base,

Stores Branch

The follg. are granted permanent commns. as Pilot Officers on probation with effect from and with seny. of Jan. 4:—P. G. Bullen, A. H. McM. Hely. W. MacI. King, G. I. Rees, A. Selby.

ROYAL AIR FORCE RESERVE RESERVE OF AIR FORCE OFFICERS

General Duties Branch

The follg. Pilot Officers on probation are confirmed in rank:—P. J. de Havilland (Oct. 30, 1933); I. C. MacLaine, C. A. Penberthy (Dec. 26, 1933); G. T. Greenhalgh (Dec. 17, 1933); D. A. Letts, D. A. Rea (Dec. 19, 1933); Archibald Reid (Dec. 28, 1933).

P/O. on probation R. C. Thorn is transferred from Class AA (ii) to class C (Jan. 14); P/O. on probation A. H. McM. Hely relinquishes his commn. on appointment to a permanent commn. in the R.A.F. (Jan. 14).

Gosport, 9.1.34. A. N. Spottiswoode, to No. 822 (F.S.R.) Sqn., 9.1.34. C. H. Williams, to R.A.F. Base, Gosport, 10.1.34.

Pilot Officer E. C. Kidd, A.F.M., to No. 210 (F.B.) Sqn., Pembroke Dock, 4.12.33.

Stores Branch

Flying Officer R. W. Wallace, to School of Store Accounting and Store-keeping, Cranwell, 4.1.34, for course of instruction, on transfer from General Duties Branch.

Pilot Officers: The undermentioned Pilot Officers are posted to School of Store Accounting and Store-keeping, Cranwell, for course of instruction, on appointment to Permanent Commns., 4.1.34:—P. G. Bullen, A. H. McM. Hely, W. MacI. King, G. I. Rees, and A. Selby.

Medical Branch

Wing Commander K. Biggs, M.C., to H.Q., Fighting Area, Uxbridge, 1.1.34, for duty as Principal Med. Officer.

Flight Lieutenants: L. C. Palmer-Jones, to Aeroplane and Armament Experimental Establt., Martlesham Heath, 1.1.34. A. E. Vawser, to R.A.F. Hospital, Aden, 29.12.33.

Dental Branch

Flying Officer C. R. Stone, to Station H.Q., North Weald, 3.1.34.

NAVAL APPOINTMENT

The following appointment has been made by the Admiralty:—**Lieut. (Flt. Lt., R.A.F.)**—R. A. Kilroy, to *Neptune*.

Royal Air Force Staff College

The following officers have satisfactorily completed the eleventh course (1933) at the Royal Air Force Staff College and are entitled to the letters "p.s.a." after their names in the Air Force Lists of their respective services:—

Royal Air Force: Sqd. Ldrs. H. M. Massey, M.C. and F. J. W. Mellersh, A.F.C. Flt. Lts. A. L. A. Perry-Keene, G. S. Shaw, W. A. B. Bowen-Buscarlet, D.F.C., T. C. Traill, D.F.C., C. Halliwell, H. J. Saker, J. A. Elliott, S. McKeever, D.F.C., B. H. C. Russell, N. V. Moreton, M. H. Ely, B. E. Embry, A.F.C., A. F. Scroggs, D. W. F. Bonham-Carter, W. A. D. Brook, I. A. Bertram, H. H. Brookes, C. W. Rugg, and L. J. V. Bates.

Royal Australian Air Force: Flt. Lts. J. P. J. McCauley and E. C. Wackett.

Royal Canadian Air Force: Flt. Lts. A. L. Morfee and J. L. E. A. de Niverville.

The following officers of the Royal Navy, the Army and the Indian Army have satisfactorily completed the eleventh course (1933) at the Royal Air Force Staff College:—

Royal Navy: Coms. A. M. Sheffield and A. C. Chapman.

Army: Bt. Major A. W. Lee, M.C.

Indian Army: Capt. R. L. Goode.

R.A.F. Apprentice Clerks

THE Air Ministry announces:—Vacancies exist in the Royal Air Force for well-educated boys (in possession of an approved first school certificate) between the ages of 15 and 17 to enter as apprentice clerks in April and July next. Entry will be by selection from among applicants with the necessary educational qualifications.

Detailed information regarding the apprentice clerk scheme can be obtained from the Secretary, Air Ministry (Apprentice Clerks Department), Gwydyr House, Whitehall, London, S.W.1. Successful candidates will be required to complete twelve years' regular air force service after reaching the age of 18. At the age of 30 they will normally return to civil life, but a limited number may, subject to service requirements, be permitted to re-engage to complete twenty-four years' service qualifying for pension.

Boys entered under this scheme will be trained up to the age of 18 (or the completion thereafter of the prescribed course) in clerical duties, typewriting, practical office routine, shorthand (for Clerks, General Duties), pay and stores accounting (for Clerks, Accounting). During this period their general education will be continued under a staff of graduate teachers.

Oil for the Air Ministry

It is announced that the Air Ministry have placed contracts with the Anglo-American Oil Company and with Itmol, Ltd., for home and overseas supplies of lubricating oil respectively. The contracts do not require oil to be supplied from any particular country, but supplies from Russian sources are permitted equally with those from other foreign countries. No suitable oils have been offered, it is stated, from oilfields within the Empire. The Sternal Company is British, and 35 to 42 per cent. of the contract price represents money to be paid to British labour.

An apprentice clerk at present receives pay at the rate of 1s. a day for the first year and 1s. 6d. a day afterwards, i.e., until he has both attained the age of 18 and successfully completed the course. Thereafter pay is at present issuable at rates commencing at from 3s. to 4s. 6d. a day (21s. to 31s. 6d. a week) according to the degree of success achieved at the final examination. In addition, free board and lodgings and an allowance for uniform are provided.

Flight Cadetships for Aircraft Apprentices—The "Lord Wakefield" Scholarship Awards

AIRCRAFT Apprentices A. R. Atkins, E. J. Bunting, and W. H. Kelk from No. 1 School of Technical Training (Apprentices) Halton, have been selected for cadetships at the Royal Air Force College, Cranwell, on the result of the examinations held on completion of their three years' training as aircraft apprentices.

The "Lord Wakefield" Scholarships valued at £75 each, have been awarded to Flt. Cadet R. W. Reynolds (on the result of the recent competitive examination for entry into the Royal Air Force College) and to Flight Cadet A. R. Atkins.

Award of Prize Cadetships, Royal Air Force.

THE Air Council have awarded Prize Cadetships, each of the value of £105 per annum for two years, to the following successful candidates at the examination held in November, 1933, for entry into the Royal Air Force College, Cranwell:—C. H. Press, Perse School, Cambridge; M. P. Skinner, Cranbrook School; J. A. Chorlton, Giggleswick School, Settle; P. J. K. Pike, Stowe School; F. R. Foster, Richmond School, Yorks; A. G. Dudgeon, Eton College.

Foreign Officers with the Royal Air Force

LIEUTENANT O. P. ARALDSEN, Norwegian Air Service, has been attached to No. 33 (Bomber) Squadron, Bicester from January 8, 1934, to February 17, 1934, inclusive.

Zone of Promotion to Wing Commander

THE Air Ministry has decided that the upper limit of the zone of promotion to wing commander in the general duties branch will be reduced to seven years seniority as squadron leader with effect from the promotions to be made on January 1, 1935. Squadron leaders of July, 1926, seniority and squadron leaders of 1927 seniorities will therefore be finally considered for promotion on 1st July, 1934.

Flying in the U.S. Navy

A JOINT CONGRESSIONAL COMMITTEE has recommended that the U.S.S. *Akron* be replaced and that the airship be used for training purposes. During 1933, the sum of £4,829,387 was voted to the U.S. Navy for their aviation programme. New cruisers, aircraft carriers and the airship *Macon* are using 212 new aircraft. The *Ranger*, the new aircraft carrier, which will be the fourth vessel of this type in the U.S. Navy, will probably be commissioned on May 1, 1934.

AIRCRAFT COMPANIES' STOCKS AND SHARES

AS compared with a month ago, there have been substantial advances in leading shares of industrial companies in response to the indications that recovery in general trade conditions is likely to continue to make favourable progress. Best prices were not maintained, the latest proposals of President Roosevelt for controlling the future of the dollar having had an unsettling influence on market sentiment and centred speculating business mainly on gold-mining shares. Shares of companies identified with the aircraft and associated industries were well maintained on balance for the month. Imperial Airways came in for active business and are little changed at 38s. 9d., compared with 38s. 3d. At one time there were unconfirmed rumours current in the market that additional shares might be issued on favourable terms to shareholders, but the fact that last month's good rise has been well held is attributed generally to wider recognition of the company's important future, which as always the price of the shares tends to discount a long way ahead. De Havilland were again higher at 38s. 6d., compared with 37s. 3d. On the basis of last year's increased dividend the yield on the shares is small, but profits were distributed conservatively, and there are prospects of a larger dividend for the current year. Fairey Aviation, which fluctuated somewhat, are also better on the month at 26s. 4½d., compared with 25s. 4½d., while there was more interest in Handley Page preference, which show a gain from 11s. 9d. to 13s. 3d. Hawker Aircraft held last month's gain, anticipations having persisted in the market that, in view of the figures given in the prospectus and reports that the company is doing well, there are reasonable prospects of the dividend being at least such as to give a satisfactory yield on the shares at their present price. D. Napier improved from 7s. 3d. to 8s. 9d., but both

Name	Class	Nominal Amount of Share	Last Annual Dividend	Current Week's Quotation
Anglo-American Oil	Deb.	Stk.	5½	101
Armstrong-Siddeley Develop.	Cum. Pref.	£1	6½	23/9
Birmingham Aluminium Castg.	Ord.	£1	7½	30/6
Booth (James), 1915	Ord.	£1	15	71/6
Do. do.	Cum. Pref.	£1	7	28/1½
British Aluminium	Ord.	£1	5	32/-
Do. do.	Cum. Pref.	£1	6	24/6
British Celanese	Ord.	10/-	Nil	13/1½
British Oxygen	Ord.	£1c	6½	46/6
Do. do.	Cum. Pref.	£1c	6½	26/10½
British Piston Ring	Ord.	£1	20	73/3
British Thomson-Houston	Cum. Pref.	£1	7	28/1½
Brown Brothers	Ord.	£1	10	49/4½
Do. do.	Cum. Pref.	£1	7½	30/-
Dick (W. B.)	Cum. Pref.	£10	5	113/9
De Havilland Aircraft	Ord.	£1	7½	38/6
Dunlop Rubber	Ord.	c	4	42/6
Do. do.	"C" Cum. Pref.	16/-	10	29/6
En-Tout-Cas (Syston)	Def. Ord.	1/-	Nil	-/6
Do. do.	Ptg. Ptd. Ord.	5/-	Nil	2/10½
Fairey Aviation	Ord.	10/-	10	26/4½
Firth (T.) & John Brown	Cum. Pref.	£1	6d	14/3
Do. do.	Cum. Pref.	£1	5* ^d	14/-
Ford Motor (England)	Ord.	£1	Nil	24/-
Fox (Samuel)	Mt. Deb.	Stk.	5	80½
Goodyear Tyre and Rubber	Deb.	Stk.	6½	104
Handley Page	Ptg. Pref.	8/-	10	13/3
Hawker Aircraft	Ord.	5/-	B	19/3
Do. do.	Red. Cum. Pref.	£1	B	21/3
Hoffmann Manufacturing	Ord.	£1	5	28/9
Do. do.	Cum. Pref.	£1	7½	26/3
Imperial Airways	Ord.	£1	5	38/9
Kayser, Ellison	Ord.	£5	1	67/6
Do. do.	Cum. Pref.	£5	6	97/6
Lucas (Joseph)	Ord.	£1	25E	60/-
Napier (D.) & Son	Ord.	5/-	Nil	8/9
Do. do.	Cum. Pref.	£1	7½	23/9
Do. do.	Pref.	£1	8A	18/9
Petters	Ord.	£1	Nil	7/6
Do. do.	Cum. Pref.	£1	7½ ^G	13/9
Roe (A. V.) (Cont. by Armstrong-Siddeley Devel., q.v.)	Ord.	£1	—	—
Rolls-Royce	Ord.	c	10	77/-
Smith (S.) & Son (M.A.)	Def. Ord.	1/-	25	7/-
Do. do.	Pt. Ptd. Ord.	£1	14	58/9
Do. do.	Cum. Pref.	£1	7½	28/9
Serck Radiators	Ord.	£1	12½	43/9
"Shell" Transport and Trading	Ord.	£1	7½*	51/10½
Do. do.	Cum. Pref.	£10	5	£12½
Sternol	Cum. Ptd. Ord.	10/-	4F	6/6
Triplex Safety Glass	Ord.	10/-	25	81/-
Vickers	Ord.	6/6	4	8/9
Do. do.	Cum. Pref.	£1	5*	23/4½
Vickers Aviation (Cont. by Vickers, q.v.)	—	—	—	—
Westland Aircraft (Branch of Petters, q.v.)	—	—	—	—

* Dividend paid, tax free. c £1 unit of stock. d Last xd. March, 1931.
A Last xd. September, 1931. B Issued this year. C Last xd. July 19, 1932.
E Also 100% share bonus. F Actual: in respect of arrears.

classes of preference shares are unchanged. Although the market is not apparently anticipating resumption of dividends on the 8 per cent. preference shares at this stage, it is hopeful of the past year's results showing improvement, while, in view of the statement at the last annual meeting as to the possibility of an eventual return of capital, increased interest may attach to the ordinary shares between now and publication of the report in March. Vickers, which continued to come in for more attention, retained nearly all their advance of the previous month. The results may also be published in March in this case. Armstrong-Siddeley preference moved in favour of holders on the good impression created by the past year's profits. There has been very little business to test quotations for Petters issues, which are the same as a month ago. In other directions, Dunlop Rubber units moved further in favour of holders, partly owing to estimates that the dividend may be increased to 8 per cent. Hoffman Manufacturing also moved up on the possibility of a larger dividend. Triplex Safety Glass are 81s., compared with 70s. 6d.; it is thought in some quarters that the company may resume paying an interim dividend. S. Smith (M.A.) show a gain of 2s. on the month to 7s., and the preferred ordinary, which carry participating dividend rights, are 58s. 9d., a gain of 10s.; Brown Brothers are higher at 49s. 4½d., as are Joseph Lucas at 60s. The latter company is expected to announce its interim dividend shortly. British Oxygen were higher on balance, and Firth & John Brown preference shares made better prices at Sheffield.

PUBLICATIONS RECEIVED

U.S. National Advisory Committee Reports: No. 460. *The Characteristics of 78 Related Airfoil Sections from Tests in the Variable-Density Wind Tunnel.* By E. N. Jacobs, K. E. Ward, and R. M. Pinkerton. Price 15 cents. No. 462. *Tests of Nacelle-Propeller Combinations in Various Positions with Reference to Wings—III. Clark Y Wing—Various Radial-Engine Configurations—Tractor Propeller.* By D. H. Wood. Price 10 cents. No. 463. *The N.A.C.A. High-Speed Wind Tunnel and Tests of Six Propeller Sections.* By J. Stack. Price 10 cents. No. 464. *Negative Thrust and Torque Characteristics of an Adjustable-Pitch Metal Propeller.* By E. P. Hartman. Price 5 cents. No. 466. *Aircraft Power-Plant Instruments.* By H. Sontag and W. G. Brombacher. Price 15 cents. No. 467. *The Experimental Determination of the Moments of Inertia of Airplanes.* By H. A. Soule and M. P. Miller. Price 5 cents. No. 472. *Wind-Tunnel Tests on Combinations of a Wing with Fixed Auxiliary Airfoils Having Various Chords and Profiles.* By F. E. Weick and R. Sanders. Price 10 cents. Superintendent of Documents, Washington, D.C., U.S.A.

Technical Notes of the U.S. National Advisory Committee for Aeronautics: No. 473. *Tank Tests of Two Floats for High-Speed Seaplanes.* By J. W. Bell. Nov., 1933. No. 474. *Effect of Stabilizer Location upon Pitching and Yawing Moments in Spins as Shown by Tests with the Spinning Balance.* By M. J. Bamber and C. H. Zimmerman. Nov., 1933. No. 475. *The Effect of Split Trailing-Edge Wing Flaps on the Aerodynamic Characteristics of a Parasol Monoplane.* By R. N. Wallace. Nov., 1933. No. 476. *The Effect of Engine Performance of Change in Jacket-Water Outlet Temperature.* By E. A. Garlock and G. Ellis. Nov., 1933. No. 477. *Aerodynamic Tests of a Low Aspect Ratio Tapered Wing with an Auxiliary Airfoil for Use on Tailless Airplanes.* By R. Sanders. Nov., 1933. No. 478. *The Effect of Slots and Flaps on Lateral Control of a Low-Wing Monoplane as Determined in Flight.* By H. A. Soule and J. W. Wetmore. Nov., 1933. No. 479. *Strength Tests of Thin-Walled Duralumin Cylinders in Pure Bending.* By E. E. Lundquist. Dec., 1933. No. 480. *The Drag of Streamline Wires.* By E. N. Jacobs. Dec., 1933. *Errata Sheet for No. 469.* U.S. National Advisory Committee for Aeronautics, Washington, D.C., U.S.A.

NEW COMPANIES REGISTERED

JEFFCOAT AND BENNETT, LTD., 5, Great Winchester Street, E.C.2.—Capital £3,000, in 2,000 "A" shares of £1 each and 2,000 "B" shares of 10s. each. Acquiring rights attaching to patents in respect of silencers for aeroplane and other engines, and to carry on the business of merchants, manufacturers of motor, electrical and ignition appliances and accessories, and in particular of silencers for aeroplane and other electrically driven and internal-combustion engines, etc. Directors: Leslie G. Jeffcoat, 24, Balham Hill, S.W.12, engineer, and Frank Bennett, 9, Lamb Street, Belle Vue Hill, Woolahra, Sydney, wool merchant.

THE AIR TRANSPORT INVESTMENT TRUST, LTD.—Capital £100, in £1 shares. Objects: to acquire and hold shares, stocks, debentures, debenture stock, bonds, obligations and securities, etc. Solicitors: Slaughter and May, 18, Austin Friars, E.C.2.

PATENT AERONAUTICAL SPECIFICATIONS

Abbreviations: Cyl. = cylinder; i.c. = internal combustion; m. = motors. (The numbers in brackets are those under which the Specification will be printed and abridged, etc.)

APPLIED FOR IN 1932

Published January 25, 1934

25,549. BENDIX AVIATION CORPORATION. Starting-mechanism for internal-combustion engines. (403,776.)

APPLIED FOR IN 1933

Published January 25, 1934

18,918. HEENAN & FROUDE, LTD., and G. H. WALKER. Screw propellers. (403,897.)

22,864. SOC. FRANCAISE DE MATERIEL D'AVIATION. Landing-trains for aeroplanes. (403,911.)